THE American JOURNAL OF Surgery

MARCH 1957

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SIXTY-SIXTH YEAR OF PUBLICATION

MARCH 1957

THE American JOURNAL OF Surgery

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(1) Farmer, D. A.: M. Clin. North America *38*:1403, 1954. (2) Lichtman, S. S.: Diseases of the Liver, Gallbladder and Bile Ducts, ed. 3, Philadelphia, Lea & Febiger, 1953, vol. 2, pp. 1146, 1150, 1302. (3) Rosser, J. H., and McCall, R. A.: U. S. Armed Forces M. J. *5*:658, 1954. (4) Schwimmer, D.; Boyd, L. J., and Rubin, S. H.: Bull. New York M. Coll. *16*:102, 1953. (5) Best, R. R.; Rasmussen, J. A., and Wilson, C. E.: A.M.A. Arch. Surg. *67*:839, 1953. (6) Pearse, H. E.: Am. J. Surg. *89*:1191, 1955.

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1. Zintel, H. A.: *Surg. Clin. North America,* 36:257, Apr., 1956. 2. Freeman, B. S.; and Young, T. K., Jr.: *Arch. Surg.,* 61:1145, Dec., 1950.

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HARRY C. SALTZSTEIN, PAUL LEVIN AND JACOB SHARP

A follow-up is presented of 572 patients with cancer, personally treated. The follow-up is 92.8 per cent complete for three years and 91 per cent complete for five years. Thirty-five per cent of the patients have been followed up ten years or more, 47 per cent five years, and 18 per cent three years.

Cancer and the Reluctant Surgeon 356
L. KRAEER FERGUSON AND MARGARET H. EDWARDS

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The American Journal of Surgery is published monthly by The American Journal of Surgery, Inc., 49 West 45th Street, New York 36, N. Y. Yearly Subscription, $15.00 U. S. A.; $16.00 Canada; $17.00 Foreign including Pan-American Countries. Single Numbers $2.00; Special and Symposium Numbers $4.00. Re-entered as second class matter February 7 1951, at the Post Office, New York, N. Y., and on February 7, 1951, at York, Pa., under the Act of March 3, 1879. March, 1957—New Series, Volume 93, No. 3. *Copyright ©, 1957, by The American Journal of Surgery, Inc.*

MANUSCRIPTS: All manuscripts should be addressed to the Editorial Office of the Journal, 49 West 45th Street, New York 36, N. Y.

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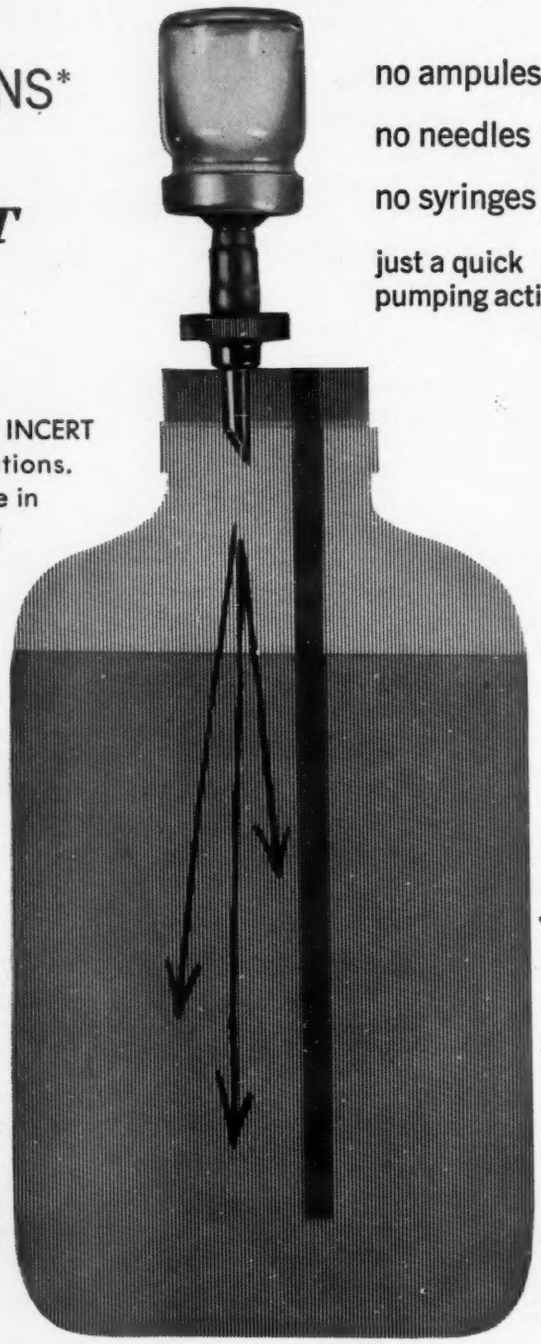

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DONALD S. MILLER

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NICHOLAS R. GREVILLE AND JOHN C. IVINS

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GORDON MURRAY, R. HOLDEN AND W. ROSCHLAU

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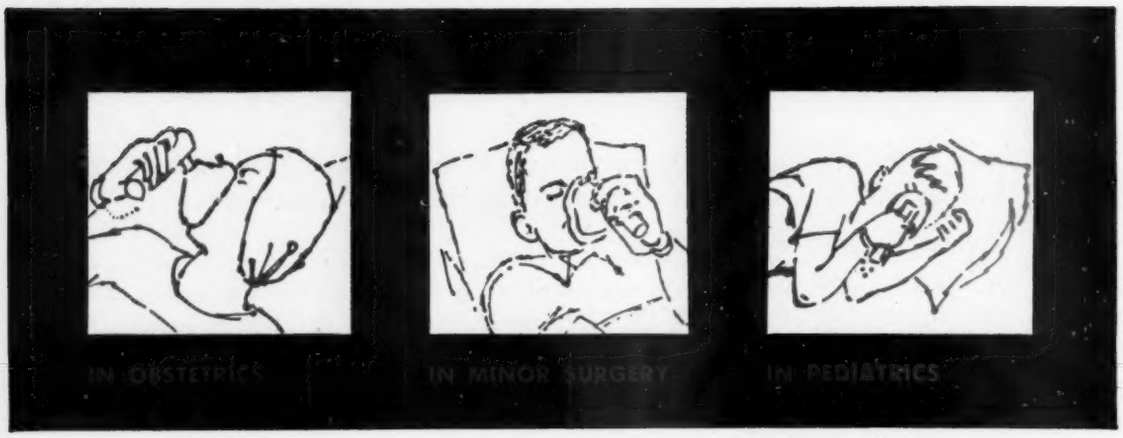

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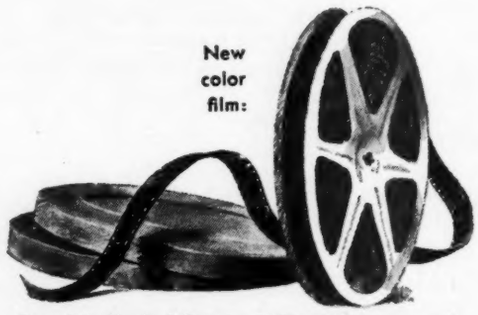

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J. WALKER DAVIS

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ERRATUM

In the February 1957 issue of the Journal, the article entitled "Congenital Anomalies of the Esophagus" by Drs. Robert R. Shaw and Donald L. Paulson, there is an error in the legend for Figure 4, page 202. The legend should read: Substernal transplantation of the jejunum and cervical esophagojejunostomy in a child in whom end-to-end anastomosis was impossible.

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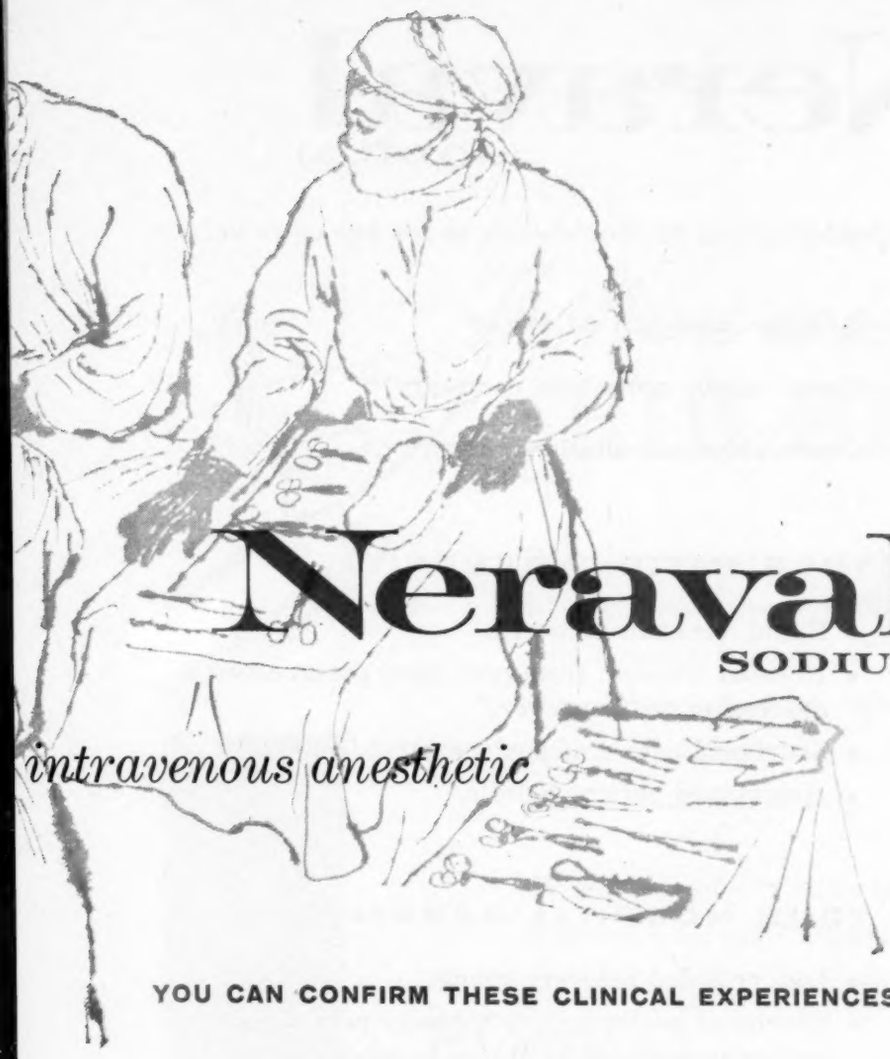

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(1) Boone, J.D.; Munoz, R., and Dillon, J.B.: Anesthesiology *17*:284, 1956. (2) Zima, O.; von Werder, F., and Hotovy, R.: Anaesthesist *3*:244, 1954. (3) Fitzpatrick, L.J.; Clarie, D'A.C., and Mersch, M.A.: Anesthesiology *17*:684, 1956. (4) Blake, M.W., and Perlman, P.L.: J. Pharmacol. & Exper. Therap. *117*:287, 1956. (5) Ayd, F.J., Jr.: Neraval: A new anesthetic for electroconvulsive therapy, Paper presented at annual meeting, Electroshock Research Association, Chicago, Illinois, April 29th, 1956. (6) Irwin, S.; Stagg, R.D.; Dunbar, E., and Govier, W.M.: J. Pharmacol. & Exper. Therap. *116*:317, 1956. (7) Reifferscheid, M., and Dietmann, K.: Deutsche med. Wchnschr. *79*:638, 1954. (8) Dietmann, K.: Deutsche med. Wchnschr. *79*:1748, 1954.

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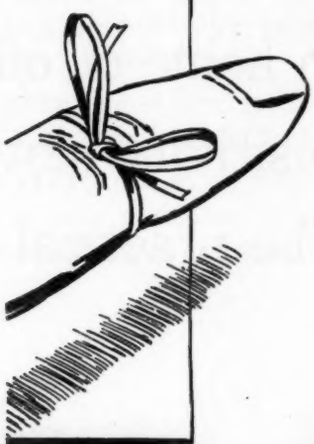

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1. Carter, C. H., and Maley, M. C.: Antibiotics Annual 1956-1957, New York, Medical Encyclopedia, Inc., 1957, p. 51. 2. Shalowitz, M., and Sarnoff, H. S.: Personal communication. 3. Shubin, M.: Personal communication. 4. La Caille, R. A., and Prigot, A.: Antibiotics Annual 1956-1957, New York, Medical Encyclopedia, Inc., 1957, p. 67. 5. Winton, S. S., and Cheserow, E.: Antibiotics Annual 1956-1957, New York, Medical Encyclopedia, Inc., 1957, p. 55. 6. Cornbleet, T.: Personal communication. 7. Loughlin, E. H.; Mullin, W. G.; Alcinder, L., and Joseph, A. A.: Antibiotics Annual 1956-1957, New York, Medical Encyclopedia, Inc., 1957, p. 63.

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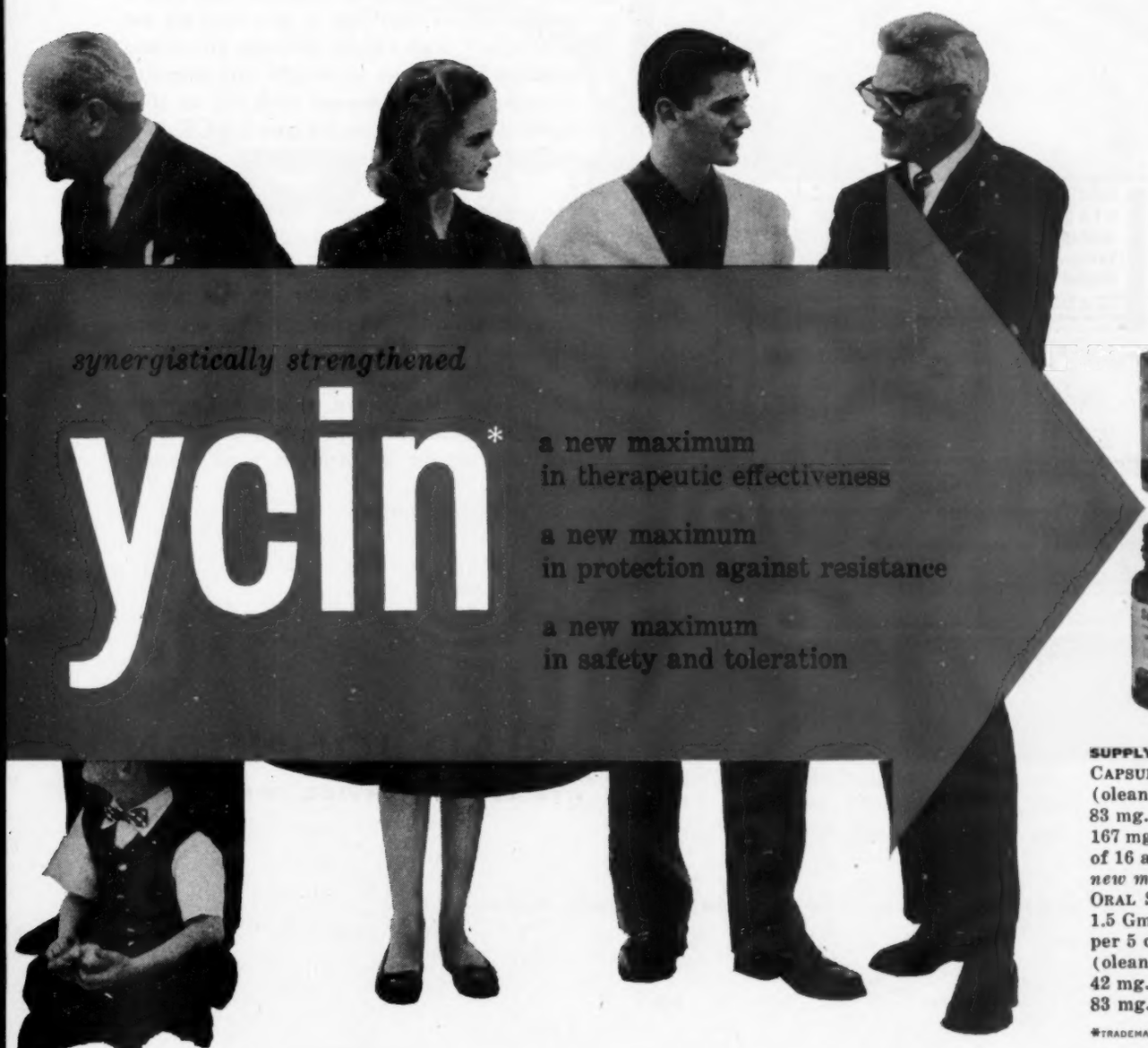

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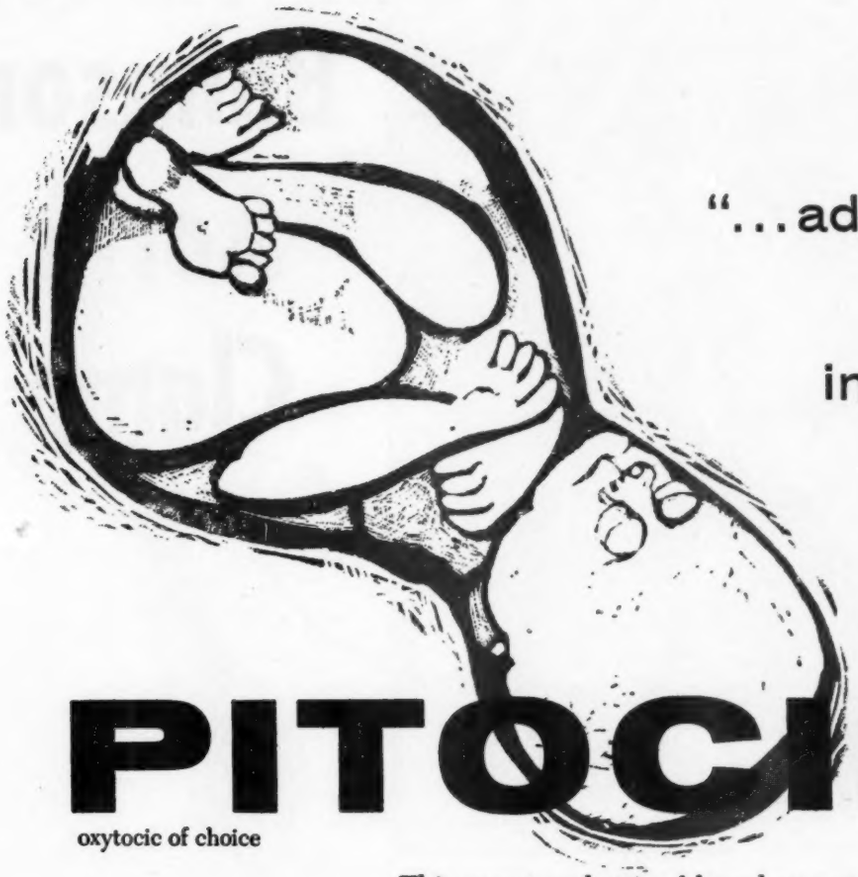

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(1) Williams, P. C., & McMahon, T. B.: *Am. J. Obst. & Gynec.* 71:1264, 1956.
(2) Stone, M. L.; Gordon, M. S., & Folsome, C. E.: *Am. J. Obst. & Gynec.* 69:140, 1955.
(3) Vroman, D. C.: *J. Omaha Mid-West Clin. Soc.* 16:24, 1955.
(4) Ratzan, W. J., & Shulman, A.: *Obst. & Gynec.* 6:493, 1955.
(5) Bishop, E. H.: *Obst. & Gynec.* 5:519, 1955.

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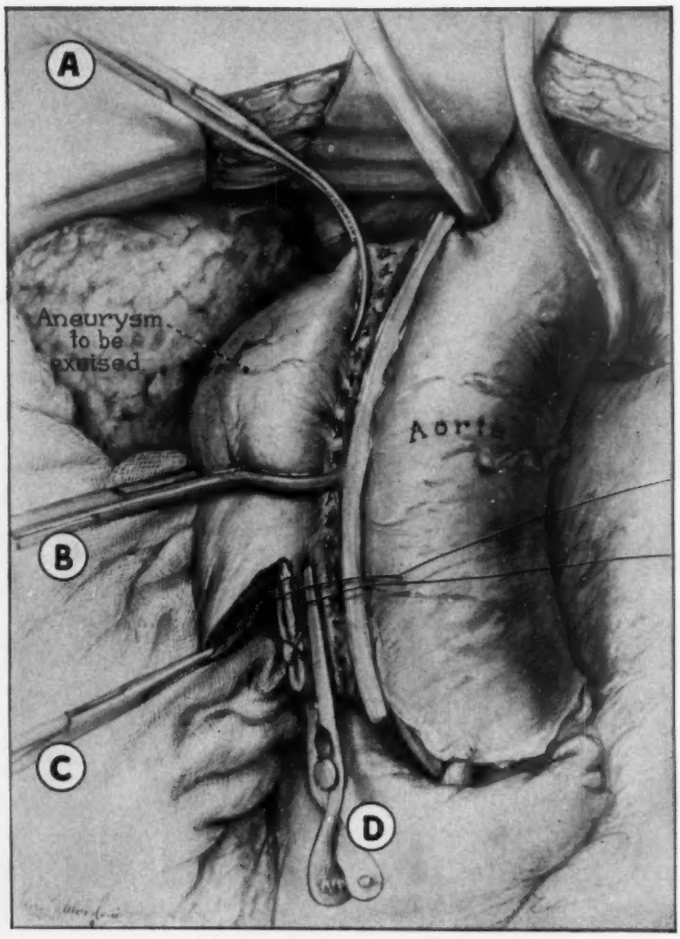

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A Th2275 Curved Forceps with *Atraugrip* jaws*. Blade 55 mm. Total length 22 cm.

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See description of operative technic, "Cystic Medial Necrosis as a Cause of Localized Aortic Aneurysms Amenable to Surgical Treatment" in Annals of Surgery, 144: 519 (October) 1956.

C B720 Kelly Hemostat, straight, $5\frac{1}{2}$ inch.

D Th2091 Bulldog Clamp with *Atraugrip* jaws, straight. Blade 27 mm. Total length $6\frac{1}{2}$ cm.

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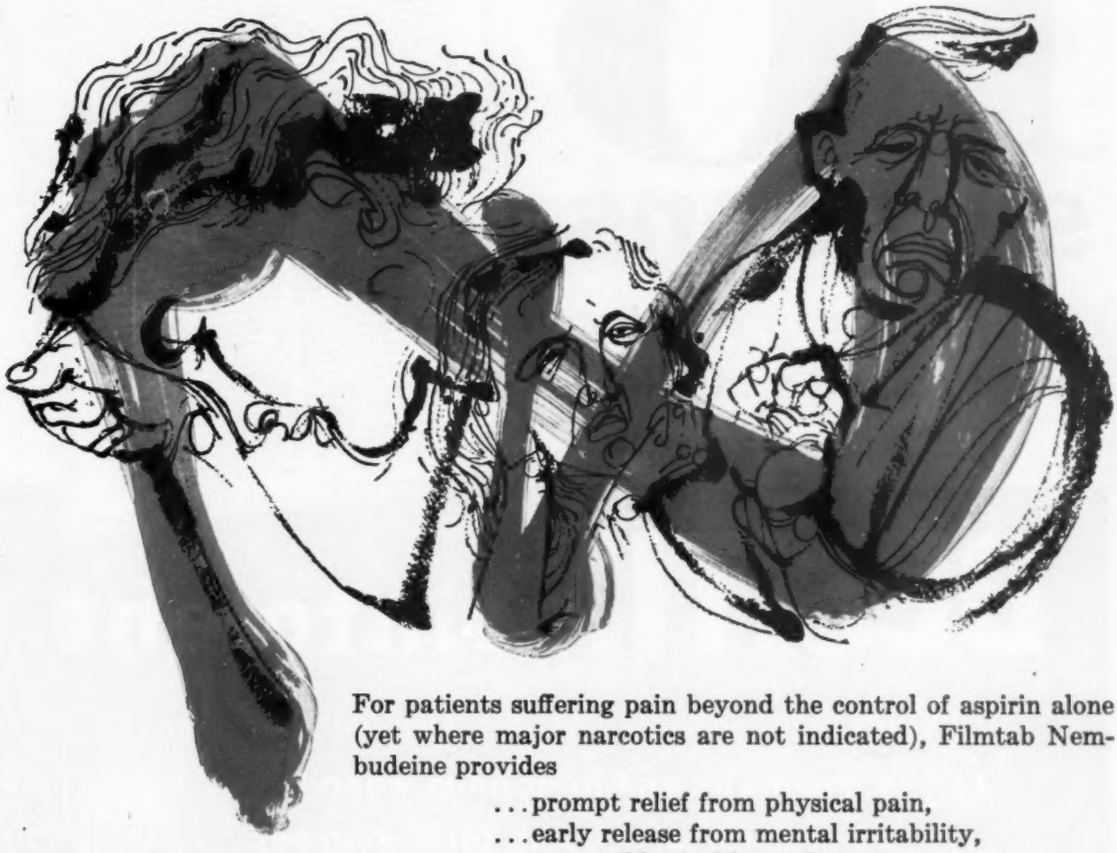

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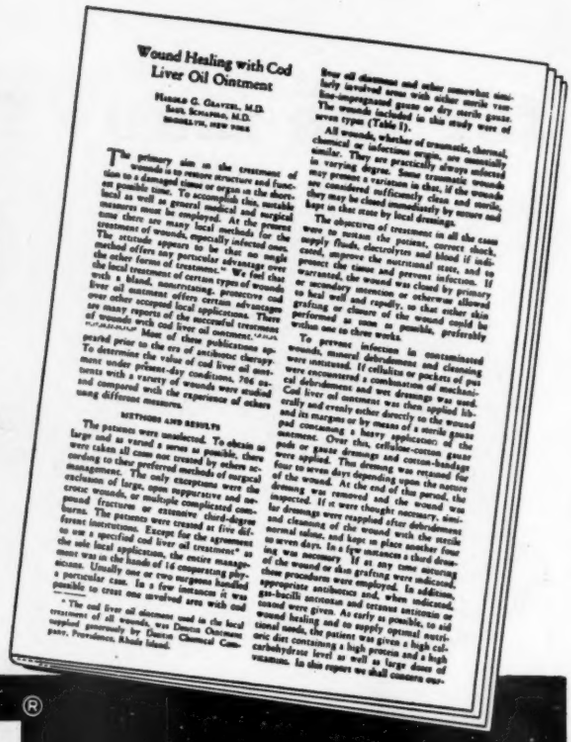

Wound Healing with Cod Liver Oil Ointment

Harold G. Grayzel, M.D.
Saul Schapiro, M.D.
Brooklyn, New York

The primary aim in the treatment of wounds is to restore structure and function to a damaged tissue or organ in the shortest possible time. To accomplish this, suitable local as well as general medical and surgical measures must be employed. At the present time there are many local methods for the treatment of wounds, especially infected ones. The attitude appears to be that no single method offers any particular advantage over the other forms of treatment.* We feel that the local treatment of certain types of wounds with a bland, nonirritating, protective cod liver oil ointment offers certain advantages over other accepted local applications. There are many reports of the successful treatment of wounds with cod liver oil ointment.[1-10] Most of these publications appeared prior to the era of antibiotic therapy. To determine the value of cod liver oil ointment under present-day conditions, 764 patients with a variety of wounds were studied and compared with the experience of others using different measures.

METHODS AND RESULTS

The patients were unselected. To obtain as large and as varied a series as possible, they were taken all come and treated by others according to their preferred methods of surgical management. The only exceptions were the exclusion of large, open suppurative and necrotic wounds, or multiple complicated compound fractures or extensive third-degree burns. The patients were treated at five different institutions. Except for the agreement to use a specified cod liver oil treatment as the sole local applicator, the entire management was in the hands of 16 cooperating physicians. Usually one or two surgeons handled a particular case. In a few instances it was possible to treat one involved area with cod liver oil ointment and other somewhat similarly involved areas with other sterile vaseline-impregnated gauze or dry sterile gauze. The wounds included in this study were of seven types (Table I).

All wounds, whether of traumatic, thermal, chemical or infectious origin, are essentially similar. They are practically always infected in varying degree. Some types of wounds may promote a variation in that, if the wounds are considered sufficiently clean and sterile, they may be closed immediately by sutures and kept in that state by local dressings.

The objectives of treatment in all the cases were to sustain the patient, correct shock, supply fluids, electrolytes and blood if indicated, improve the nutritional state, and to protect the tissue and prevent infection. If warranted, the wound was closed by primary or secondary suture, or otherwise allowed to heal well and rapidly, so that either skin grafting or closure of the wound could be performed as soon as possible, preferably within one to three weeks.

To prevent infection in contaminated wounds, mineral debridement and cleansing were instituted. If cellulitis or pockets of pus were encountered a combination of mechanical debridement and wet dressings was used. Cod liver oil ointment was then applied liberally and evenly either directly to the wound and its margins or by means of a sterile gauze pad containing a heavy application of the ointment. Over this, cellulose-cotton gauze pads or gauze dressings and cotton-bandage were applied. This dressing was retained for four to seven days depending upon the nature of the wound. At the end of this period, the dressing was removed and the wound was inspected. If it were thought necessary, similar dressings were reapplied after debridement and cleansing of the wound with the sterile normal saline, and kept in place another four to seven days. In a few instances a third dressing was necessary. If at any time suturing of the wound or skin grafting were indicated, these procedures were employed. In addition, appropriate antibiotics and, when indicated, gas-bacilli antitoxin and tetanus antitoxin or toxoid were given. As early as possible, to aid wound healing and to supply optimal nutritional needs, the patient was given a high caloric diet containing a high protein and a high carbohydrate level as well as large doses of vitamins. In the report we shall concern ourselves

* The cod liver oil ointment used in the local treatment of all wounds, was Desitin Ointment supplied generously by Desitin Chemical Company, Providence, Rhode Island.

DESITIN® ointment

promotes "early, clean and healthy healing"

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- traumatic and infectious wounds
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This confirms previous findings regarding the efficacy of soothing, protective, non-irritant Desitin Ointment—rich in cod liver oil—to accelerate healing in many other skin conditions . . . diaper rash, ulcers (decubitus, varicose, diabetic), etc.

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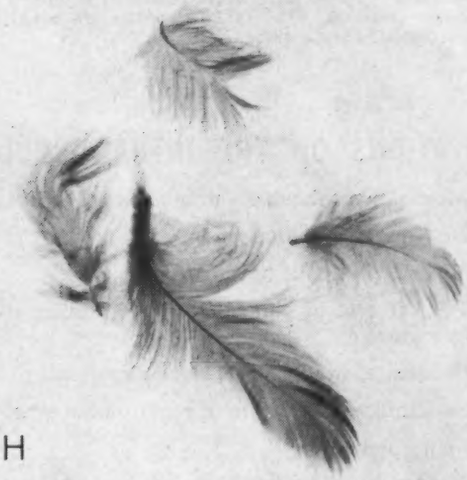
1. Grayzel, H. G., and Schapiro, S.: Western J. Surgery, Obstet. & Gyn., Oct. 1956.



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Advancing with surgery

[1] Miller, J. M.; Surmonte, J. A.; Ginsberg, M., and Ablondi, F. B.: Streptokinase Intramuscularly in the Treatment of Infection and Edema. (Scientific Exhibit) *Postgraduate Medicine* Vol. 20, No. 3: 260-267 (Sept.) 1956.

Postgraduate Medicine

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1. Most patients showed beneficial clinical effect after 24 hours.
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7. No fibrinolysis.†
8. Some pain and tenderness at injection site in about 60 per cent of cases.
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10. No granulomas at injection site.
11. No chills, cyanosis or allergic reaction.

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Five thousand units of streptokinase in 0.5 cc. of physiologic saline administered intramuscularly twice a day for at least six doses. Treatment may be continued longer if necessary. It may be given preoperatively where considerable edema is expected postoperatively.

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2. Streptokinase should not be given to patients known to have defects in the clotting mechanism."

†No fibrinolysis detectable in circulating blood stream.

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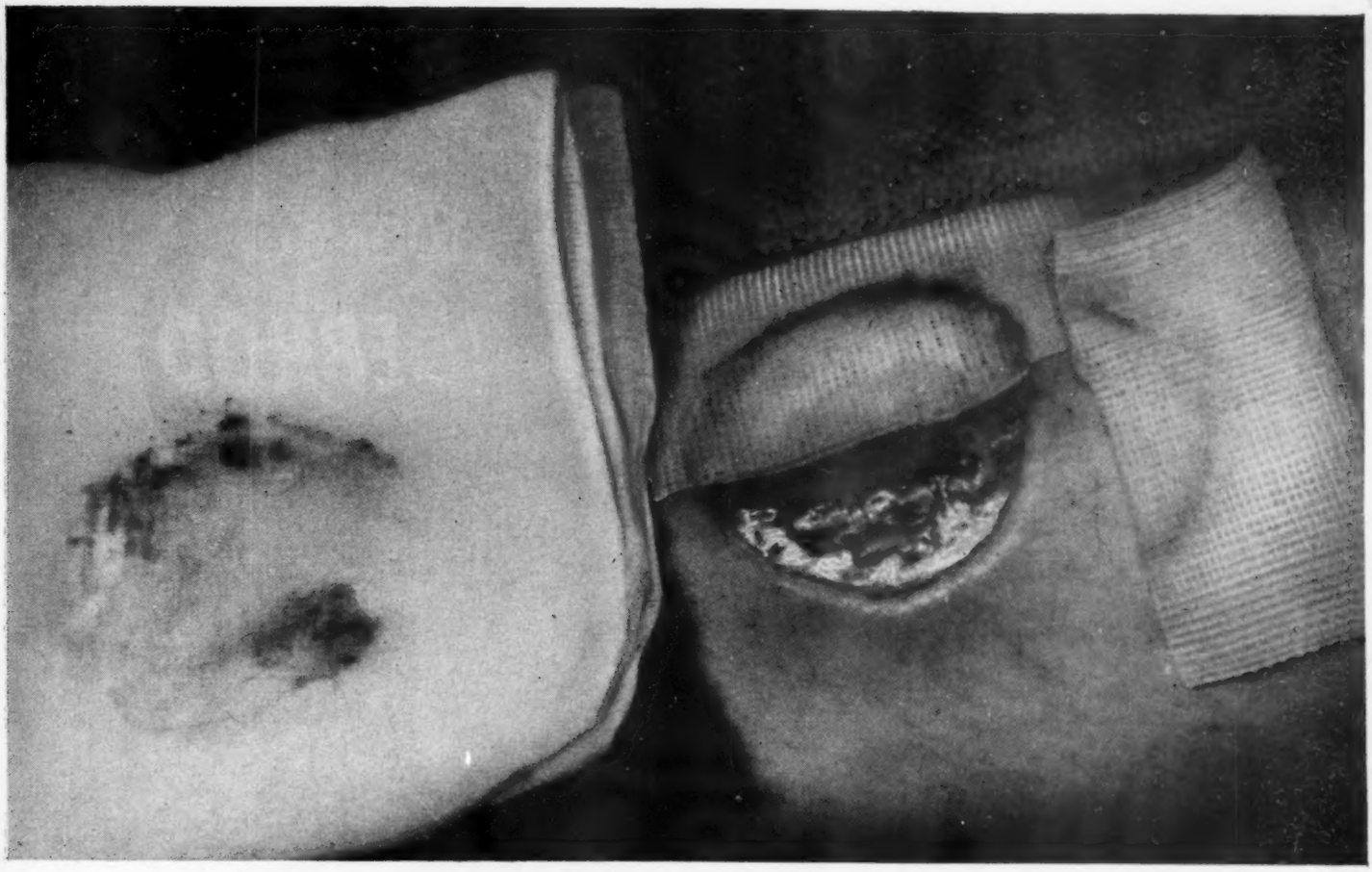

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New growth tissue cannot become entangled with the dressing. A special bland petrolatum emulsion covers the fabric without clogging the pores.

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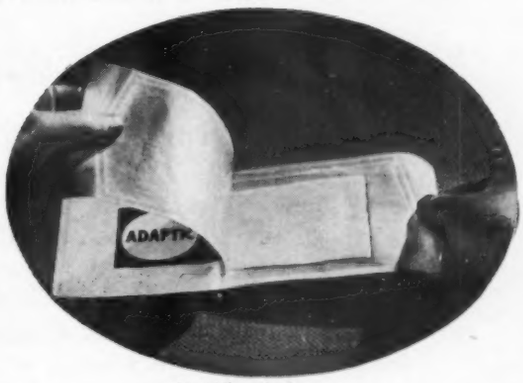

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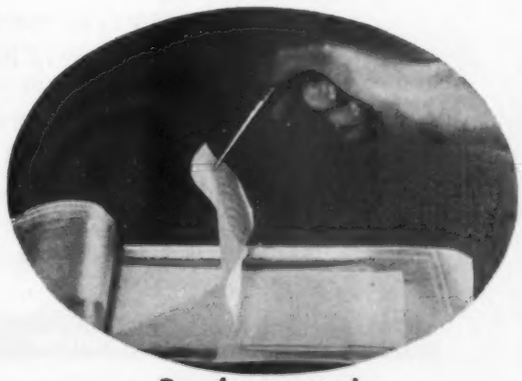

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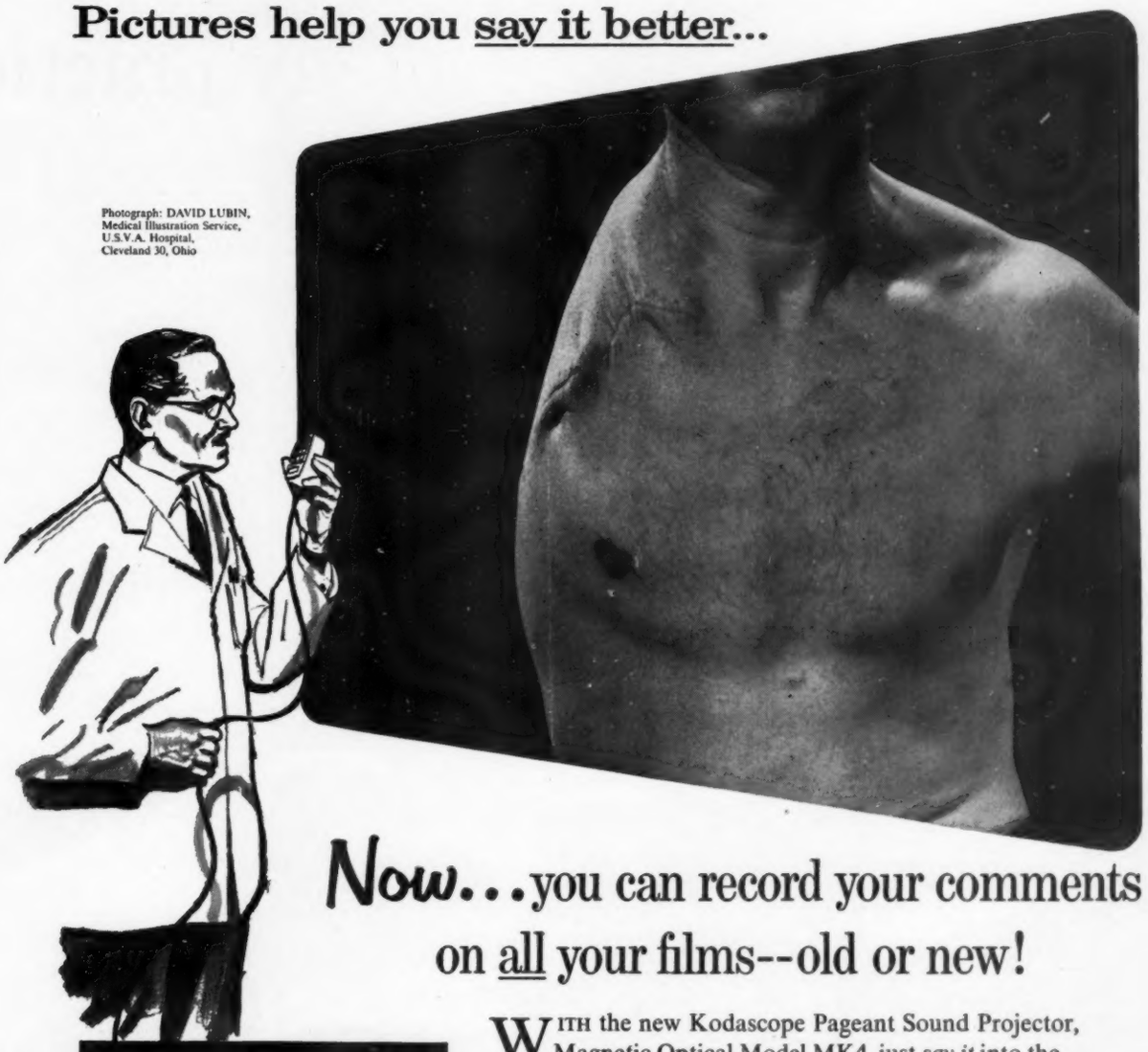

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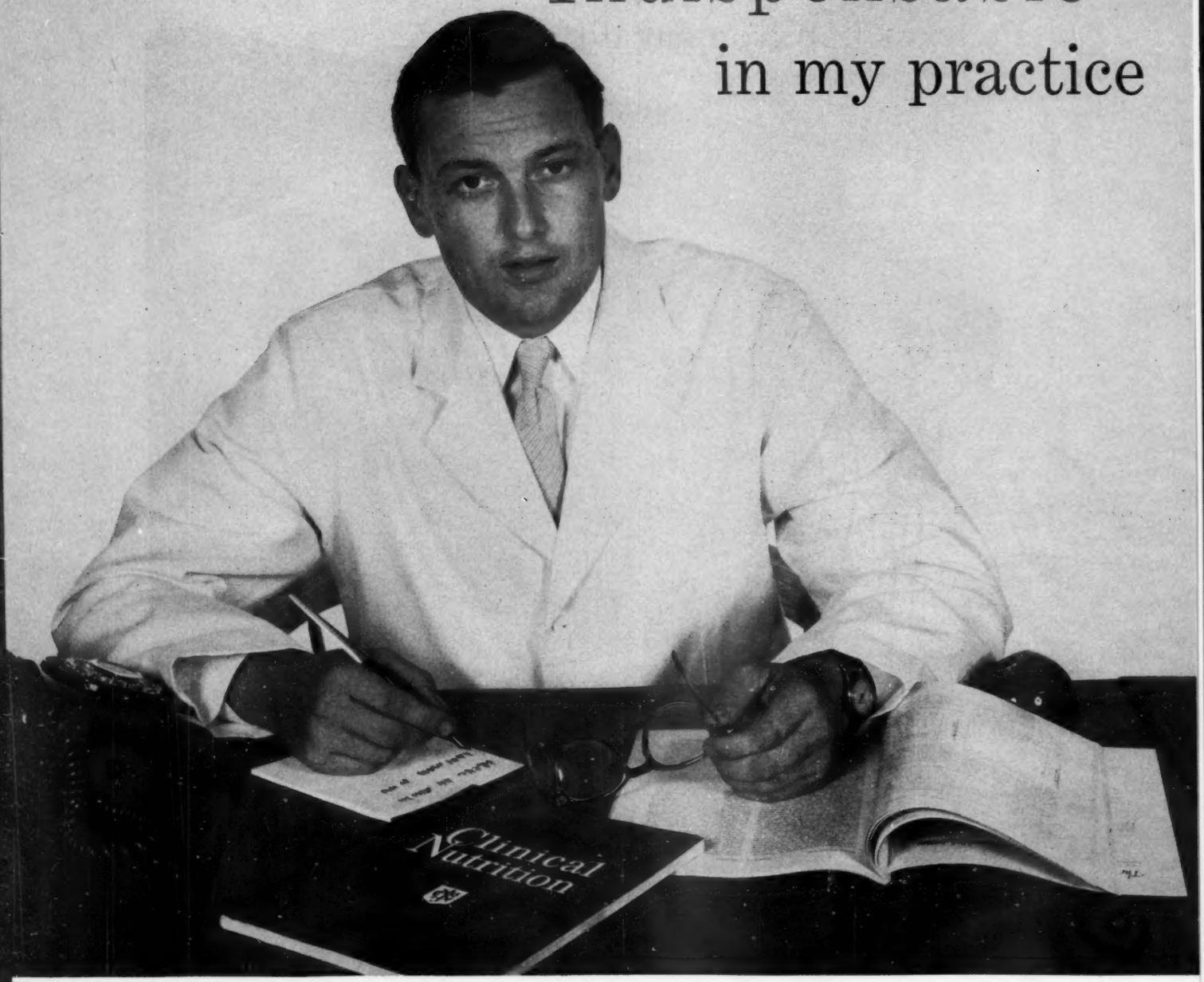

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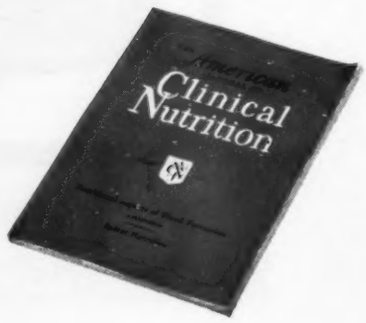

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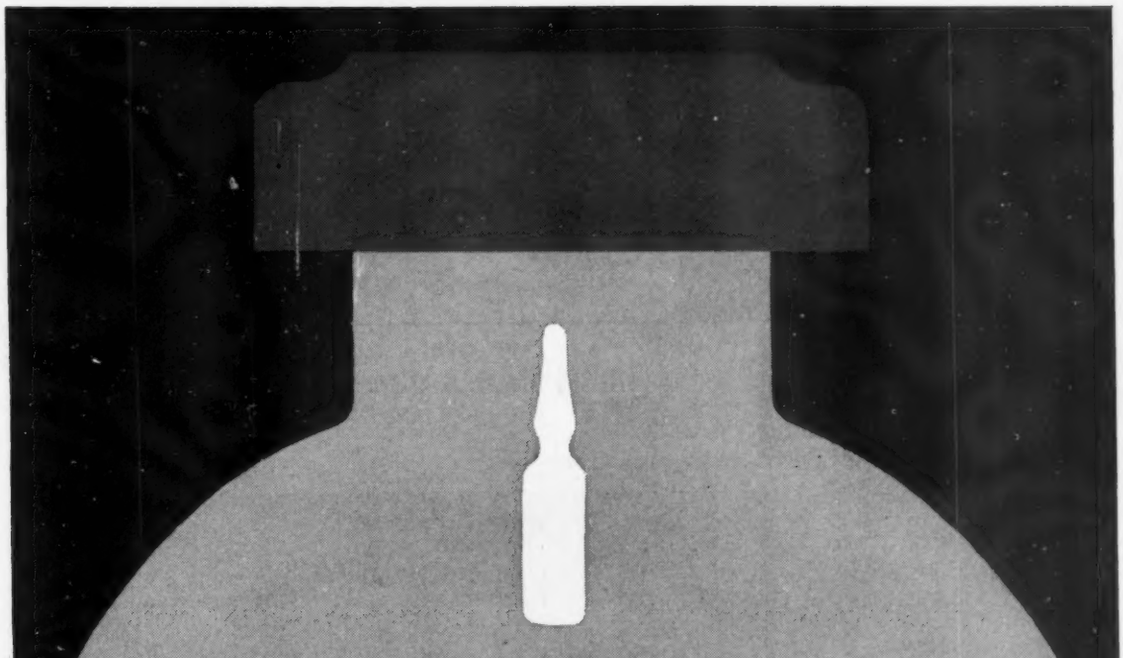

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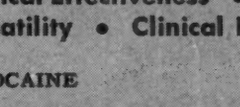

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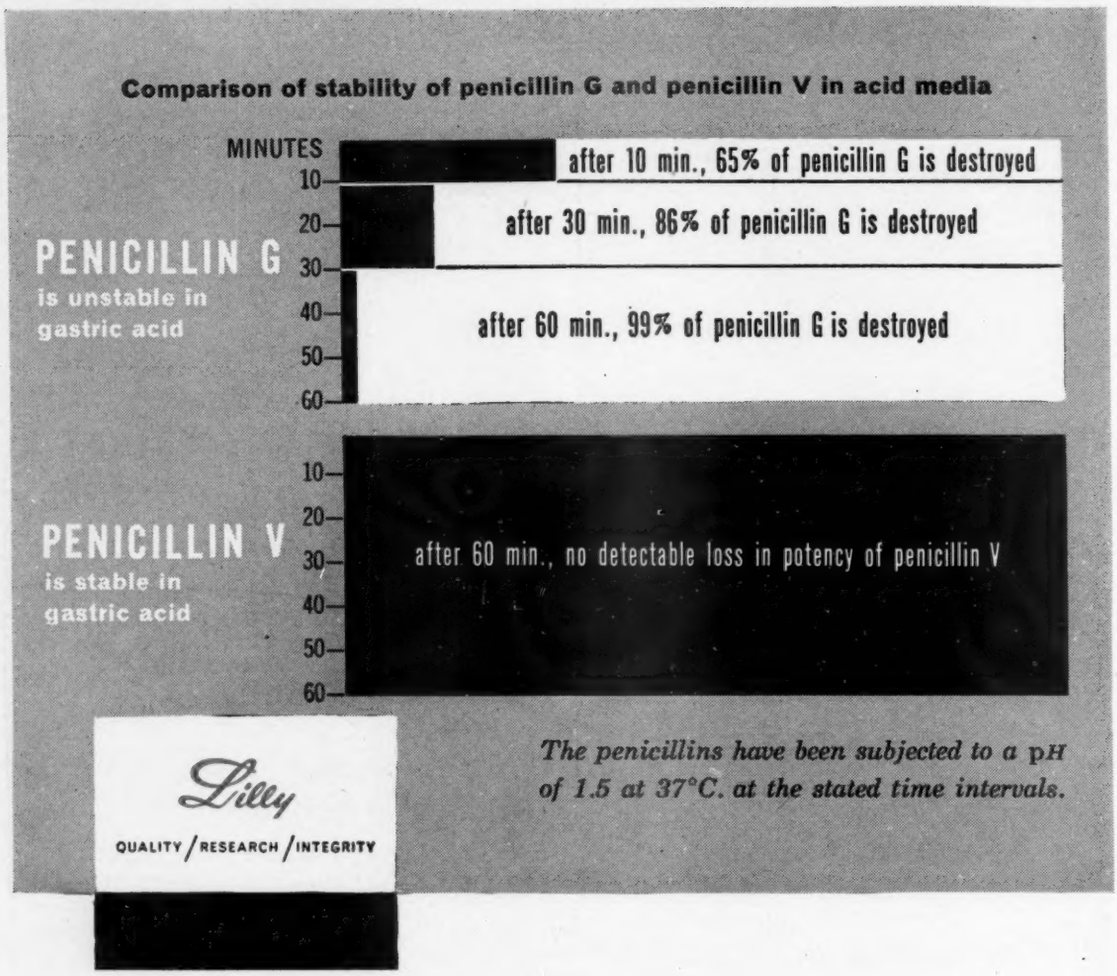
Comparison of stability of penicillin G and penicillin V in acid media
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10
20
30
40
50
60
PENICILLIN G
is unstable in gastric acid
after 10 min., 65% of penicillin G is destroyed
after 30 min., 86% of penicillin G is destroyed
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The American Journal of Surgery

VOLUME 93 MARCH 1957 NUMBER THREE

EDITORIAL

Important Considerations in Maxillofacial Injuries

THE high speed of present day travel is responsible for the ever increasing number of severe crushing injuries to the face and jaws. The final results obtained in these cases are dependent upon early recognition and efficient treatment.

The importance of a thorough examination in all cases of traumatic injuries to the face cannot be overemphasized. Frequently circumstances do not permit a very thorough roentgenographic examination because of the difficult position needed to procure a good film. Therefore, great caution should be exercised to prevent fractures from being overlooked. Since these patients are usually first seen by the general surgeon, this matter becomes his responsibility. Close collaboration with the oral surgeon is of the utmost importance as he usually can detect fractures of the jaws and facial bones by inspection and careful palpation. The presence of malocclusion, inability to open or close the mouth, together with deformity and pain, are indicative of fracture.

If the physical examination appears to reveal a fracture, the radiographic confirmation may be delayed until further recovery has taken place. In the interim, fixation may be achieved. If the radiographic examination then does not reveal a fracture, the exercised caution and treatment can in no way affect the patient adversely.

Many facial injuries are accompanied by severe shock and intracranial complications which demand immediate attention to save the patient's life. The control of hemorrhage, the establishment of an unobstructed airway and the relief of pain constitute the early routine.

In fracture wounds of the face it is not unusual to find foreign particles or spicules of teeth and bone. Surgical cleansing of the wound is the first step before immobilization of the fracture is attempted, as infection is the principal complication in these cases. At least 600,000 units of penicillin should be administered twice a day. When there is a history of sensitivity to penicillin, erythromycin, 100 mg. every six hours intramuscularly or 250 to 500 mg. every six hours orally, should be used.

The Mayo Clinic suggests that patients receiving steriod therapy carry a card as diabetics do, indicating how much cortisone, meticorten or ACTH they are receiving or have received and for how long a period, because of the possibility of irreversible shock due to trauma or surgery. It is recommended that these patients be given cortisone or meticorten forty-eight hours, twenty-four hours and two hours before operation, and two days postoperatively.

Temporary immobilization with the proper type of bandage aids in preventing further injury and adds to the patient's comfort. Four-tailed and Gibson bandages are the most satisfactory because they create upward traction under the mandible. The four-tailed bandage is as its name implies. The ends are

split and tied on top of the head causing traction under the chin. The Gibson bandage is a modification of the Barton in which the turns pass beneath the chin instead of in front; the bandage is secured by several alternating turns around the forehead.

If the patient is seen soon after the accident and is in good condition, the fracture should be reduced immediately. However, it is often a safer policy to delay the approximation several days or until it is reasonably certain that the strenuousness of the operation will be well endured.

From the many methods and appliances used for the reduction of maxillary fractures, it is evident that no one appliance is suitable or adaptable to all types of fractures encountered.

Each case presents different problems and the results are in direct proportion to the skill of the operator. The treatment consists of correcting the facial deformity, re-establishing normal occlusion and maintaining the fragments in their proper apposition until union occurs. Usually a perfect anatomic position means a perfect functional result.

In fractures of the jaw when a sufficient number of teeth are present, direct intermaxillary wiring is the simplest method of fixation. It affords the opportunity of observing the occlusion during the entire process of healing so that any accidental displacement which might occur can easily be noted.

Direct intermaxillary wiring is the fixation of the lower to the upper jaw by means of wires fastened directly to the necks of the teeth and twisted until the teeth are brought into occlusion. The ends of the wires are then cut off short and bent so as not to cut into the soft tissues.

With the advent of World War II, direct intermaxillary wiring was rejected because of the hazard of motion sickness. Since then intermaxillary arch wiring with rubber band traction has preferential usage. This method of wiring a pliable metal arch to the upper and lower teeth with hooks or spurs affords the advantage of gradual traction when the rubber bands are interposed, plus the safety of rapid cutting in an emergency.

When patients with bone fragments requiring reduction and fixation do not have sufficient teeth available for wiring, other methods have to be used, such as circumferential wiring, direct fixation of the fragments with internal wire sutures, vulcanite, acrylic or metal splints, and plaster or other headgear with elastic traction under the mandible, or the use of a Forrester collar. Extraoral skeletal fixation may be used alone or in conjunction with other appliances whether or not teeth are present.

Circumferential wiring is used to immobilize fractures of the mandible in patients without natural teeth. Wires are passed around the body of the mandible and twisted over a splint placed on the dental ridge. If the patient is wearing a lower denture, this may serve as a splint.

The use of a Lane plate secured with screws is occasionally necessary when approximation and immobility cannot otherwise be secured.

The Gunning type of interdental splint was once very popular but is now seldom used in the treatment of fractured jaws. Because of the possibility of error in restoring normal occlusion, its use is generally limited to edentulous cases.

Impressions of the dental arches are taken in plaster or compound and the model of the involved arch is sawed through the line of fracture. The pieces are accurately fitted to simulate normalcy and the splint is made from this model. The material used in the construction of the interdental splint is either vulcanite, acrylic resin or metal. When teeth are present, the splint is held in place with cement. In edentulous patients, elastic traction under the mandible from a plaster headcap keeps the interdental splint in place.

The simplest method of making a plaster head cast is as follows: One end of a piece of stockinette is drawn over the head and brought below the occipital protuberance, just above the ears and on a level with the zygomatic arches, and just above the eyebrows; the other end is tied on top and the excess cut off. Four strips of orthopedic felt, 6 inches long and 1 inch wide, are placed vertically on the stockinette, one in each quadrant, and held in place with adhesive. Plaster banadges, 3 inches wide, are immersed in water and applied as a head bandage. The hooks are cut from ordinary wire coat hangers and are incorporated in the plaster, one in front of each ear. These are used as traction posts for a piece of 5 inch rubber dam or a 3 inch bandage with tape (Davol) which goes under the chin, creating constant upward pressure.

Cranial anchorage, however, has many dis-

advantages such as instability, discomfort, tissue irritation and necrosis. Many facial injuries are complicated by head injuries, thus making the use of a headcap impossible. An appliance to overcome this disadvantage has been designed, basing the anchorage below the mandible and occipital level by using a Forrester collar and an adjustable framework of spring steel wires which immobilizes the head to the trunk and can duplicate any and all of the features accomplished by a headgear.

Direct wiring to the malar bones provides another important means of reduction and immobilization of maxillary fractures, eliminating the use of external appliances. The approach is entirely intraoral. Stainless steel wires are attached from the malar bones to any desired type of intraoral appliance used for controlling the fragments.

Fractures of the malar bone frequently occur as a result of direct trauma to the area and are usually unilateral. The fracture may be overlooked by the masking of the deformity by edema and the difficulty of visualizing the fracture on x-ray examination. The zygomatic arch, composed of the malar and temporal bone is the weakest area and is more frequently fractured. Injuries to the infraorbital, frontal and maxillary processes occur less often. Fractures of the zygomatic arch are usually accompanied by difficulty in opening the mouth wide because of interference of the depressed zygoma with the coronoid process, or in closing the mouth if open at the time of accident.

Depressed malar fractures may cause permament facial deformity, interference with mastication or produce visual and ocular disturbances if not promptly and properly reduced. Correction of this condition is best accomplished by elevating the fragments with a uterine tenaculum inserted through the soft tissues of the cheek. This method is simple, it causes no disfigurement and the deformity is not likely to recur unless the bones are badly shattered. Infraorbital wiring to a headgear, packing the antrum with gauze or inflating the antrum with a balloon sometimes becomes necessary when the anterior wall of the maxillary sinus is crushed. If fibrosis has occurred, the Gillies technic or intraoral elevation through an incision in the mucobuccal fold posterior to the malar bone is used.

Infiltration or block anesthesia is usually sufficient to insure comfort in all of these procedures. However, when marked deformity and muscular spasm are present, general anesthesia is indicated. The anesthetic of choice is one which produces relaxation with relative absence of nausea. Intravenous anesthesia with intubation comes closer to filling these requirements; its comparative safety and the method of administration make it ideal for operations about the face.

A suture placed through the tip of the tongue, long enough to draw it forward, should be a routine procedure if the jaw is to be immobilized under general anesthesia.

Cleanliness of the mouth at all times is of the utmost importance especially in compound fractures in which the possibility of osteomyelitis is ever present.

It is not necessary to remove teeth to feed the patient whose jaws are wired together. There is sufficient space behind the last molars to permit liquids to be taken freely. A high caloric diet should be prescribed and at least 6 to 8 ounces taken every two hours.

In conclusion, the following factors cannot be too strongly emphasized: (1) Fractures of the face are not always accompanied by conspicuous deformity. Early recognition and treatment of the fracture is of paramount importance. (2) Malunion, non-union, ankylosis, loss of function and many other serious complications are in many cases caused by faulty diagnosis and delay in treatment. (3) In the treatment of fractures of the jaws, bony union without disfigurement, good occlusion and normal function are the results desired. (4) Close cooperation between the oral and general surgeon in treating patients with injuries to the face and jaws is indispensable.

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The Possibilities and Limitations of Surgery in Cancer

A FOLLOW-UP OF 572 PERSONALLY TREATED PATIENTS

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"THE modern surgeon should not ask himself, 'can I get away with this operation,' but rather, 'what does the future hold for this patient?' "*

This paper represents a study of the end results of therapy in 572 personally treated patients with cancer. (Table I.)† The series is consecutive; all patients treated are included and all cases were personally followed up. The number of cases in each body region is not large, but the observation and follow-up date back twenty to twenty-five years in some cases. Thirty-five per cent have been followed up ten years or more; 47 per cent have been followed up five years, and 18 per cent have been followed up three years. The follow-up is 92.8 per cent complete for three years, and 91 per cent complete for five years. Table II gives the over-all three-year and five-year survival rates with the number of patients traced in each category.

TABLE I

Years Treated	No. of Cases
1928–1935	5
1936–1940	33
1941–1945	160
1946–1950	270
1951–1952	104

In the following analysis the five-year end results will be emphasized, since this figure is the more standard one used for comparison. Percentage figures indicate patients living without clinical evidence of disease.

As our population grows older, we must spend more time and center greater interest on diseases associated with the later years of life; our hospitals are becoming filled with patients who have cardiovascular disorders, gastrointestinal diseases and cancer. It is easy to see that many of the major problems, both diagnostic and therapeutic, in the average general hospital today concern the care of patients with cancer. In Detroit, three new 200 bed hospitals were opened in 1953. In one of them (Sinai Hospital, with a capacity of 212 beds), a review of the mortality in the hospital for the first year showed the following:

Thirty-four patients died following operations. Eighteen deaths (more than one-half) were due to cancer; fifteen of these patients were in a rather advanced stage of the disease. Of the non-operative deaths in the surgical servive, five of the total eleven were terminal malignancies. In addition, there were thirty deaths from terminal cancer in the medical service [1].

INTRA-ORAL CANCER

Seventy-six patients were followed up five years, and an additional eleven were lost to follow-up. (Table III.) The material is hetero-

* From the preface of "Surgical Pathology" by Loren V. Ackerman. St. Louis, 1953. C. V. Mosby.

† Elizabeth Levy, B.S., M.D. and Teresa Scanlan, R.N. assisted in the compilation of these data.

TABLE II
OVER-ALL SURVIVAL RATES*

Location of Cancer	Total No. of Patients	No. Traced	Patients Living Three or More Years after Surgery†		Total No. of Patients	No. Traced	Patients Living Five or More Years after Surgery‡	
			No.	Per cent			No.	Per cent
Mouth	96	84	43	45	76	65	36	47
Primary in neck	36	31	17	47	23	19	11	48
Abdomen	179	177	46	25	129	127	32	25
Pelvis	38	33	14	37	32	26	11	34
Breast	122	112	72	59	89	79	51	57
Miscellaneous sites	101	94	39	39	71	66	24	34
Totals	572	531 (92.8%)	231	40§	420	382 (91%)	165	39§

NOTE: These footnotes apply also to data in Tables III through VIII.
* Survival rates are based on total number of patients treated. Those patients lost to follow-up are assumed dead.
† Three-year follow-up includes patients treated up to August 31, 1952.
‡ Five-year follow-up includes patients treated up to August 31, 1950.
§ These figures indicate percentage of patients living without clinical evidence of disease.

TABLE III
INTRAORAL CANCER

Location of Cancer	Total No. of Patients	No. Traced	Patients Living Three or More Years after Surgery		Total No. of Patients	No. Traced	Patients Living Five or More Years after Surgery	
			No.	Per cent			No.	Per cent
Lip	20	15	12	60	16	11	9	56
Gingiva	23	21	10	43	16	14	10	63
Floor of mouth	9	8	4	44	5	4	2	40
Buccal mucous membrane	10	7	5	50	10	8	3	30
Tongue	29	28	11	38	25	24	11	44
Roof and palate	5	5	1	20	4	4	1	25
Totals	96	84	43	45	76	65	36	47

geneous. Some of the patients had been treated many years ago. Therefore, the statistical information does not lend itself to finite conclusions. However, we believe that on the basis of this experience, certain pertinent impressions and deductions may be stated.

Lip. Cancer of the lip usually occurs in old men with loose, thin lips. The greater number of patients in this series were treated by local excision. Some of the patients with smaller lesions received radiation therapy. Local cure is not difficult to accomplish, either by excision, cautery destruction or radiation.

Tongue and Buccal Mucous Membrane. Cancer in these sites includes a variety of types: superficial, papilliferous, fungating, ulcerating and infiltrating. The small, superficial papillary growths can often be very easily cured by any of the standard procedures, namely, simple excision, cautery destruction or radiation; the latter may be given either externally, internally via a cone or by means of radium needles. We

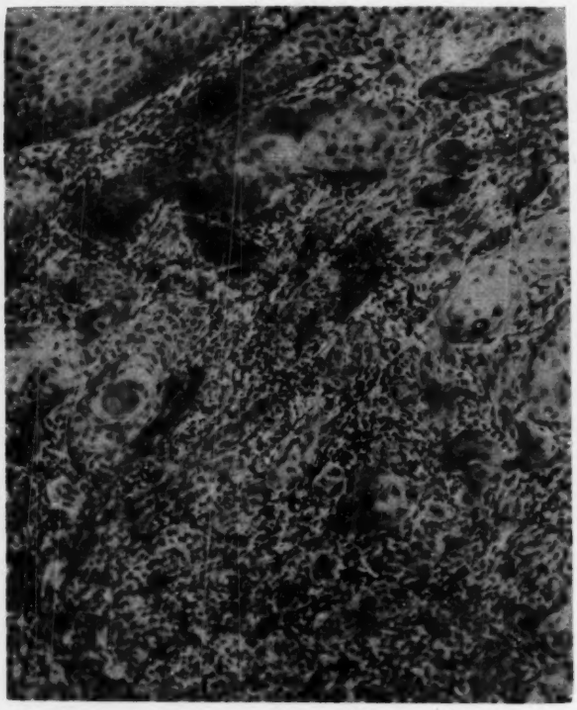

FIG. 1A. Case 1. Thirty-seven year old man. Local excisional biopsy of squamous cell carcinoma in middorsum of tongue. Photomicrograph of lesion. Squamous cell carcinoma, grade 2. Nothing further was done.

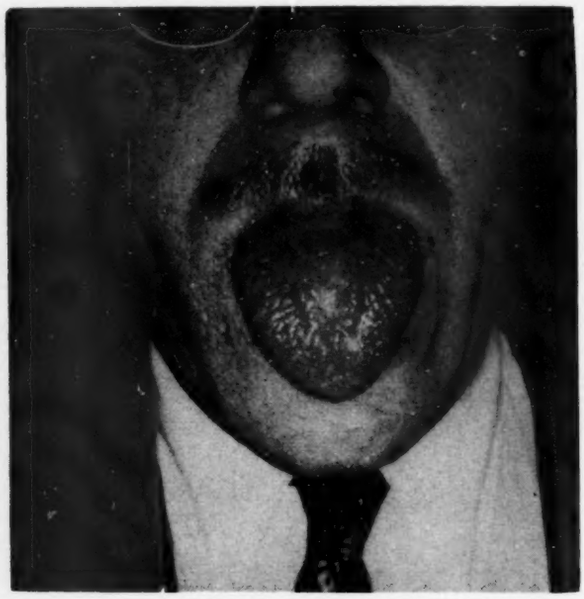

FIG. 1B. Case 1. Photograph of patient six years later. Scar cannot be found; patient is well.

have thought that external radiation gave as good results in the hands of someone quite familiar with the potentialities and limitations of x-ray therapy as did internal radiation or radium needles.

Larger growths are preferably excised. X-ray will not cure the deeper infiltrating lesions and cautery destruction leaves a large sloughing open wound which is liable to secondary bleeding. X-ray therapy often leaves a smooth normal-appearing mucosa, somewhat dry, but therapeutically much more restored to normal than surgery can accomplish. However, one cannot be sure which patients will have this result or which will have an atrophic, paper-thin, sensitive, tongue surface, with pain during mastication. These changes may be permanent. The chief deterrent against x-ray therapy, however, is the unpredictable necrosis of the mandible which may follow a cancerocidal dose.

NECK DISSECTIONS

Lip. We feel certain that prophylactic neck dissection is not indicated in the treatment of cancer of the lip when no nodes are palpable.

Buccal, Tongue. For tongue lesions, our present feeling is one of uncertainty. We have followed the dictum that prophylactic neck dissection should not be performed in the absence of palpable nodes. When the primary lesion in the tongue is arrested (and as stated, some of these superficial lesions heal very readily and are easy to cure), our practice has been to follow up these patients very carefully—once a month for a year and then once every two months for another year. The philosophy is that a palpable node can be found in time for cure by radical neck dissection. It is certain that if radical neck dissections were performed on all patients with cancer of the tongue, there would be a good deal of unnecessary operating. Crossed metastasis to the opposite side of the neck is frequent in cases of cancer of the tongue. The operation is a much more drastic procedure than that of axillary dissection accompanying breast removal, to which an analogy is often made. However, several clinics now advocate prophylactic neck dissections for cancer of the tongue whereas others, such as Memorial Hospital in New York, have not thought it indicated.

Larynx. Our clinical impression of neck dissection for carcinoma of the larynx is that patients may have a better chance of staying well following metastasis to the neck from carcinoma of the larynx than from intraoral carcinoma. The reason may be that the metastatic deposits from laryngeal cancer seldom spread

above the level of the hyoid bone, and the cancer field can be more easily circumscribed.

RADICAL NECK AND JAW DISSECTIONS

After a certain amount of experience with this procedure, we believe that it should not be performed in far advanced cases in which there is not too great a likelihood of cure. One can easily take the position that the disease is going to be fatal, therefore, there are no contraindications to very extensive procedures. This is often true, but on the other hand, in advanced cases it can represent needless surgery and no beneficial result from the procedure, with the accompanying deformity. Recurrence may proceed more rapidly either via the lymphatics of the pterygoid fossa or on the edges of the site of neck dissection (for example, along the posterior cervical chain, high up near the mastoid nodes or low in the neck). Nevertheless, radical neck and jaw dissection is coming to be a much more popular method of therapy for a large variety of intraoral cancers, especially those of the tongue, floor of the mouth and gingiva.

X-RAY THERAPY IN THE NECK

In our experience, x-ray therapy in the neck can sterilize a small focus (1½ to 2 cm.) of carcinoma or a small, discrete involved node in the neck because the beam can be coned down into a cancerocidal dose over a small area. A cancerocidal dose cannot be administered to the entire neck. Judging from the present day concensus, we do not believe that x-ray therapy has much to offer, either prophylactically or therapeutically, for metastatic cancer of the nodes in the neck, except for the afore-mentioned cases.

Our chief impression of intraoral cancer, after a fair amount of experience, is the opportunity for and necessity of individualization of the treatment of such lesions, and often the unpredictableness of the spread. The following three cases illustrate these points.

CASE I. A small lesion appeared in the middorsum of the tongue in a thirty-seven year old man. He had had the habit of continually holding the tip of his cigarette holder at this point. The lesion had been locally excised (excisional biopsy) shortly before we saw him. Microscopic examination revealed squamous cell carcinoma of the tongue, grade 2. (Fig. 1A.) This man was a lawyer and a politician, and disability of his tongue would have totally incapacitated him. Close observation was elected, and nothing further was done. He has been well for six years. (Fig. 1B.)

FIG. 2. Case II. A seventy-two year old man. Small carcinoma on left side of tongue near tip was widely excised. Photograph shows massive infiltration of left side of neck and jaw three to four months later. Radical neck and jaw resection was performed. Three months later large metastases appeared on right side of neck. The patient died three or four months later.

CASE II. A seventy-two year old man had a small cancer on the left side of the tongue near the tip. It was excised with a wide margin. Three or four months later a massive deposit was attached to the undersurface of the left mandible. (Fig. 2). Radical dissection of the neck and jaw on the left side was performed. Three months later a large metastasis appeared on the right side, and he died in another three or four months. There was no local recurrence in the tongue.

CASE III. This patient had a carcinoma on the anterior floor of the mouth and has remained well for ten years following four small radium implants; this was the only treatment given.

PRIMARY CANCER OF THE NECK

The number of patients in each category of primary cancer of the neck is again small. (Table IV.) Only cancer of the thyroid will be commented upon: of eleven patients, three had carcinomas of the more solid anaplastic type.

FIG. 3A. Case IV. Papillary adenocarcinoma of thyroid gland. Nodule, 3 cm. in diameter, along anterior border of right sternomastoid muscle below hyoid bone of one year's duration. Total right lobectomy plus excision of this nodule was performed in November, 1950.

FIG. 3B. Case IV. Metastatic nodule appeared on opposite (left) side of the neck high up, just underneath mastoid eminence in May, 1955 (four and a half years later). Right radical neck dissection at the time of the first operation would not have prevented this recurrence in the opposite side of the neck.

Of these, two died a few months after operation. The third patient had a large intrathoracic mass; at operation it was found to be adherent to the large mediastinal vessels. Subsequently she had a lingering course with symptoms of mediastinal recurrence (substernal pressure and difficulty in swallowing) which started three months after operation and continued for exactly five years until she died.

The remaining eight patients (73 per cent) had papillary adenocarcinomas. This conforms with Dinsmore's recent observation [2] that 65 per cent of patients with cancer of the thyroid (seen at the Cleveland Clinic) had this low grade variety. He quoted another series in which the figure was 80 per cent. This represents an unexplained increase in the relative incidence of papillary versus solid thyroid carcinomas during the past two decades. At the time of surgery all had metastatic nodes along the jugular chain underneath the sternomastoid or in the posterior (supraclavicular)

TABLE IV

PRIMARY CANCER OF THE NECK

Location of Cancer	Total No. of Patients	No. Traced	Patients Living Three or More Years after Surgery		Total No. of Patients	No. Traced	Patients Living Five or More Years after Surgery	
			No.	Per cent			No.	Per cent
Pharynx	4	3	0	0	4	3	0	0
Larynx	13	11	4	31	8	6	3	38
Parotid	8	6*	4	50	3	2	1	33
Thyroid	11	11*	9	92	8	8	7	88
Totals	36	31	17	47	23	19	11	48

* One patient living with recurrent disease.

TABLE V
CANCER OF THE ABDOMEN

Location of Cancer	Total No. of Patients	No. Traced	Patients Living Three or More Years after Surgery		Total No. of Patients	No. Traced	Patients Living Five or More Years after Surgery	
			No.	Per cent			No.	Per cent
Stomach	60	59	3	5	44	43	1	2
Pancreas	12	12	0	0	8	8	0	0
Gallbladder and common duct	5	5	0	0	3	3	0	0
Colon	74	73	31	42	54	53	24	44
Rectum	28	28	12	43	20	20	7	35
Totals	179	177	46	25	129	127	32	24

triangle (the previously so-called lateral aberrant carcinomas of the thyroid, which term has rightly been abandoned).

Treatment of these papillary tumors consisted of thorough removal of the nodal spread, but no radical neck dissections were performed. In addition, extensive thyroidectomy was done, usually total on the involved side. Of the eight patients with papillary adenocarcinomas, seven have remained well more than five years. In one, there was recurrence, but on the opposite side (Case IV).

CASE IV. This thirty-seven year old woman originally had a metastatic 3 cm. nodule beneath the right sternomastoid muscle at the hyoid level, and a primary nodule in the lateral portion of the right thyroid lobe. Total right lobectomy and resection of the aforementioned metastatic node were performed. Four and a half years later a nodule appeared on the left (the opposite) side of the neck, high up beneath the mastoid eminence and underneath the left sternomastoid muscle. (Fig. 3.) The microscopic picture appeared identical. Presumably, radical neck dissection on the right (original) side would not have prevented the recurrence on the left.

Here again, present opinions differ and although some clinics (Mayo Clinic and Cleveland Clinic) with a large volume of clinical material conform to the aforementioned opinion, i.e., radical neck dissection is not indicated in papillary adenocarcinoma of the thyroid, others (Memorial Hospital, New York, and John Hopkins, Baltimore) believed that all patients with this disease should undergo radical neck dissection. These cases represent a very low grade type of carcinoma and judgment must be based on a ten- to fifteen-year follow-up rather than the usual five years. Nevertheless, our feeling is that performing radical neck dissections on all of these patients would represent much unnecessary surgery.

CANCER OF THE STOMACH

Our experience with this condition is one of disappointment. As Table V indicates, of forty-four operations, only one patient has lived five years. Only one was lost to follow-up. Again, variability in prognosis is indicated by the following two cases.

CASE V. This patient had an ulcer on the lesser curvature with definite involvement of the nodes of the gastrohepatic omentum. The patient lived for four and a half years, then terminal ascites developed.

CASE VI. This patient had a polypoid growth on the lesser curvature which was rapidly excised by wedge-shaped local resection (not subtotal gastric resection) because the patient had malignant hypertension. He lived for three and one-half years in comfort, and then died of hypertension. There were no further symptoms of disease in the stomach.

Some of the forty-four patients had early

lesions, but none had been borderline microscopic diagnoses. The operations have been radical; but we have not done total gastrectomies, including the spleen and pancreas, for moderate-sized growths in the lower portion of the stomach. We do not believe that wide total resection including the spleen, half of the pancreas, the omentum, et cetera will effect a cure in very many patients with carcinoma of the stomach because the lymphatic spread underneath the duodenum is so rapid and so frequent.

CANCER OF THE PANCREAS

Our experience parallels that of others. All twelve patients were followed up, and all had died by the end of the three-year period. Nine died within three months, one died in nine months, and another within two years.*

We have not been impressed with the results of radical resection of the head of the pancreas. Patients may live longer after short-circuiting procedures than after radical operations (Cases VII and VIII).

CASE VII. This patient (previously reported [3]) lived for four years following cholecystenterostomy.

CASE VIII. Following a radical Whipple resection for a small carcinoma in the head of the pancreas, a large metastatic mass developed in the liver and the patient died three months after the operation.

Carcinoma of the papilla of Vater and the few instances of carcinoma of the common duct are, of course, a different story. One patient with carcinoma of the common duct is now living and well one and a half years following resection and Roux-Y anastomosis. The treatment of carcinoma of the gallbladder also is disappointing. We have not performed wide excision of portions of the liver for this condition. The only way to eliminate carcinoma of the gallbladder, we believe, is to remove all gallstones prophylactically. We do not remember having seen a patient with carcinoma of the gallbladder who did not have a long history of chronic gallstone disease.

* Since 1951 we have operated on twelve additional patients with carcinoma of the pancreas. Nine died within three months; three lived four months only.

CANCER OF THE COLON

The outcome is more hopeful for patients with cancer in the lower abdomen. Of fifty-four patients who underwent resection of the colon, fifty-three of whom were followed up for five years or more, 44 per cent were living and well at the end of the five-year period. Some of our patients with extensive carcinomas of the colon, which had grown into contiguous structures, have remained well for a long time following resection. The following case illustrates this point.

CASE IX. G. G., a sixty year old woman, had carcinoma of the sigmoid colon. The cancer had grown into a neighboring loop of small bowel, forming an enterocolic fistula. Double resection was performed, with end-to-end anastomosis of the ileum and then of the sigmoid colon. Metastatic nodes were found to be involved at the time. The patient lived in good health for ten years. Suddenly, backache developed and she died of retroperitoneal metastases six months later. The original growth was proved by microscopic section to be identical with the primary. (Figs. 4A and B.)

On the other hand, there have been a few instances in which we were surprised at the rapid spread following resection of a relatively small lesion in which we had expected a long-time "cure."

In two instances the roentgenologist has picked up a recurrence at the anastomotic suture line. We resected the recurrent growths and the patients have stayed well for several years.

CANCER OF THE RECTUM AND ANUS

Results of treatment of cancer of the rectum and anus show 35 per cent five-year cures in twenty cases (somewhat less than in the colon). In the postoperative follow-up, there have been some cases in which malfunction of the stoma developed several months after operation.

Because we have seen a sufficient number of recurrences which manifested themselves as stony-hard masses involving the entire perineum, we are hesitant to perform sphincter-saving operations for low lying growths.

CASE X. One exception, however, was that of a sixty year old man who was severely

FIG. 4A. Case IX. Carcinoma of sigmoid invaded neighboring loop of ileum by direct extension. Double resection with end-to-end anastomosis of sigmoid and ileum was performed. Positive nodes were noted in subjacent mesentery of both loops at time of surgery. Patient was well for ten years, then upper abdominal retroperitoneal metastases developed from which she died in six months. Lateral view of lumbar spine aortagram, showing the recurrence. Note bulging of aorta from retroperitoneal mass, and erosion of body of third lumbar vertebra.

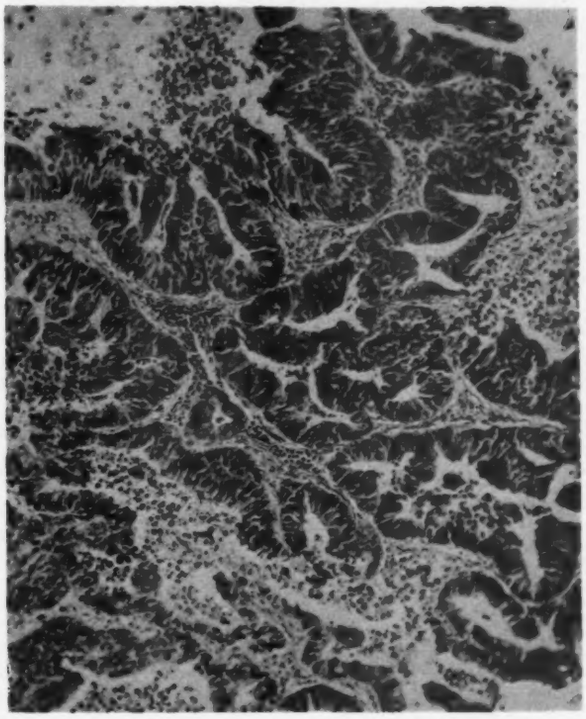

FIG. 4B. Case IX. Microscopic appearance of retroperitoneal biopsy specimen. Note similarity to adenocarcinoma of bowel.

crippled with arthritis and had a stiff poker back including the neck, pelvis, hips and knees. He could not bend down to fasten his shoes and had to put them on with a cane. Anterior resection was performed for a growth which was not more than 8 cm. above the anus. He has remained well for four years.

CANCER OF THE CERVIX

Table VI contains data on sixteen patients treated and followed up for five years; five were lost to follow-up and six lived for five years

TABLE VI

CANCER OF THE PELVIS

Location of Cancer	Total No. of Patients	No. Traced	Patients Living Three or More Years after Surgery		Total No. of Patients	No. Traced	Patients Living Five or More Years after Surgery	
			No.	Per cent			No.	Per cent
Ovary	13	12	2	15	11	10	2	18
Uterus	7	7	4	57	4	4	2	50
Cervix	16	12	6	38	16	11	6	38
Vulva	2	2	2	..	1	1	1	..
Totals	38	33	14	37	32	26	11	34

TABLE VII
CANCER OF THE BREAST

Axillary Metastasis	Total No. of Patients	No. Traced	Patients Living Three or More Years after Surgery		Total No. of Patients	No. Traced	Patients Living Five or More Years after Surgery	
			No.	Per cent			No.	Per cent
Present	44	43	21	48	31	30	12	39
Absent	54	53	41	76	40	39	31	78
Questionable	24	16	10	42	18	10	8	44
Totals	122	112	72	59	89	79	51	57

(38 per cent). Our experience with far advanced cancer of the cervix has been extensive; but most of these patients were treated years ago when radiation therapy was the only mode of therapy. One or two patients received a very small amount of radium, 15 mg. for forty-eight hours, and have remained well.

The treatment of cervical cancer is changing and is now going through the stage in which the optimum treatment for any particular case is hard to determine. Prognostic judgment must be obtained from large numbers of cases and from the experience of a very thorough, long time follow-up. Again we have the impression that often one cannot predict which patients will remain well and which will not.

OVARIAN CARCINOMA

The results are only fair: 18 per cent five-year cures in eleven patients. Kreiger of the Cleveland Clinic has recently commented on the low rate of cure of ovarian carcinoma [4]. He states that the correct diagnosis is suspected in 50 per cent of cases, and at surgery 40 per cent of the patients have inoperable carcinoma. Five-year survival rates approximate 15 to 20 per cent. His conclusion is that we can hope to cure no more carcinomas of the ovary than could an authority (William P. Dewees) writing in 1826, 130 years ago. Dewees wrote of the ovaries: "They are very liable to disease but very little susceptible to cure."

CANCER OF THE BREAST

Our experience with this condition is fairly extensive. Of 122 cases, eighty-nine were operated upon five years ago, and seventy-nine (88 per cent) were followed up for five years. (Table VII.) As stated previously, those patients lost to follow-up were counted as dead.

The five-year cure rate was 78 per cent when nodes were not involved, and 39 per cent when nodes were involved. In another group in which nodes were questionable (not always noted specifically on the chart), the five-year cure rate was 44 per cent.

Breast tissue may be found in any subcutaneous area from the mid-sternum to far out in the posterior axillary region, and from the clavicle to the costal margin [5]. Carcinoma may start in an isolated island of breast tissue far out laterally along the latissimus muscle border, or lower axillary region, or a nodule in this location may be metastatic from an occult malignancy in the breast which is not palpable. Hence, the operative dissection must be very extensive; it has usually taken from two to three or three and a half hours. In more of the recent cases, skin grafting has followed operation. The reason for this is not that we believe wider excision of the skin and a skin graft results in fewer local metastases, but that the axilla can be protected and have more freedom of motion if the skin flaps are carefully held down in the axilla and the open area in the chest is disregarded for the moment. There has been very little disability of the arm, and only an occasional patient has had permanent swelling of a marked degree. Most of these patients have not had routine postoperative x-ray therapy. We agree with other expressed opinions that "the axilla is the domain of the surgeon . . . When the proper operation has been done, there are very few recurrences in the axilla" [12]. That this removal of superficial and axillary tissue is curative in a high percentage of

cases is attested to by the results obtained: Axilla negative, 78 per cent five-year "cures"; axilla involved, 39 per cent five-year "cures."

SURGICAL LIMITATIONS IN CANCER OF THE BREAST

We have performed radical mastectomies on all patients in whom the breast was not fixed to the underlying chest wall and there was no extensive axillary invasion or very extensive edema of the skin. However, in several borderline cases we have regretted the surgical procedure. In a few instances, it has seemed to hasten the spread of the disease. Those patients in whom there was a high degree of involvement in the axillary nodes, especially if near the axillary vein, or in whom there was a large area of pitting edema over the breast (not the usual so-called inflammatory cancer) have not remained well even after careful and thorough dissection, whether or not they have received x-ray therapy. In such cases the disease often grows so rapidly and is so uniformly fatal that it is best not to perform surgery. The following two cases illustrate this point.

CASE XI. A twenty-seven year old woman noted two months preoperatively that the left breast was hard compared to the right. The hardness was first noted over the entire breast, chiefly above the nipple. A large mass involved the central half of the left breast. There was no edema of skin. Radical mastectomy was performed on December 14, 1946. "There were several large matted and very dense nodes immediately below the axillary vein so that this portion of the dissection was done as thoroughly as possible. Both nerves were sacrificed. Four inch defect left for subsequent skin graft." Local skin nodules were noted seven months later (Fig. 5), and she died in another seven months. The total duration of her illness was seventeen months.

CASE XII. D. F., a fifty-three year old woman, was first seen on October 19, 1954. She had had a "lumpy" right breast, but the lump had become larger nine months ago. Two months previous to examination a lump appeared in the right axilla. One month later a lump appeared in the right anterior axillary fold and the skin on the right breast became wrinkled. Examination showed an 8 by 8 cm. stony hard mass, with edema of the skin over a small area. Lower axillary nodes were visible as an enlargement, and there was some redness over a small area above the nipple. Wide radical mastectomy was performed on October 29, 1954. During convalescence it was noted that she had mild hyperthyroidism. She was admitted to the hospital two months later for thyroidectomy. Just before operation, a small node was noted in the right supraclavicular region. A biopsy specimen was found to be positive for cancer (January 5, 1955). Backache (metastatic) began one month later (four months postoperatively in February, 1955), and in another month it was incapacitating.

FIG. 5. Case XI. Rapidly growing cancer of breast in a twenty-seven year old woman. Two-month history of carcinoma of left breast. Mass involved half the breast. No edema of skin. Nodes were positive high in axilla close to axillary vein. Local skin recurrence seven months later. Patient died after seven months. Such patients have not remained well.

The limitations of surgery in treating cancer of the breast can be seen in Figure 6. We can remove a wide area of the superficial spread in the breast and can competently extirpate the spread into the adjoining axilla. (Fig. 6, *1.*) Spread into the pleural cavity via the intercostal and subpleural lymphatics (Fig. 6, *2,3 and 4*) is not mentioned so frequently in the literature, but it is important; it is a direct

pathway to the paravertebral lymph chains and many hidden spinal metastases occur via this route. We are powerless against this. Metastases into the internal mammary chain (Fig. 6, *5*) has already occurred in 50 per cent of cases of cancer arising in the inner quadrant, according to several recent reports.

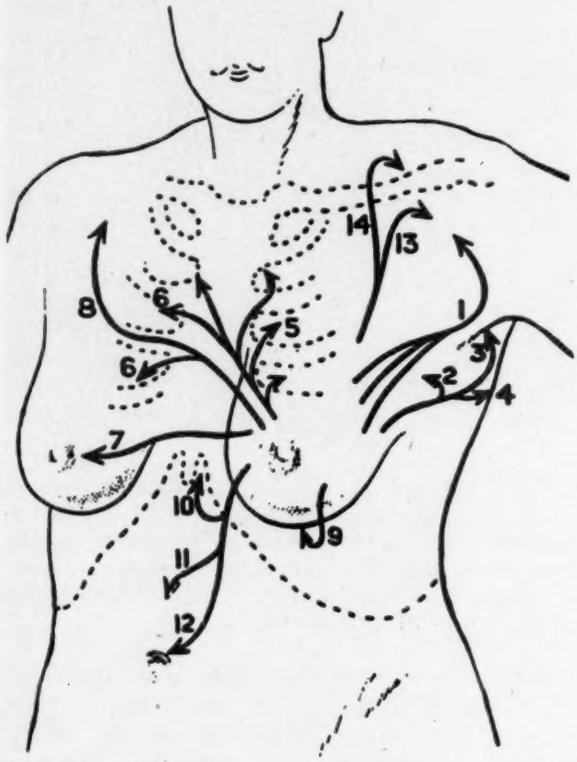

FIG. 6. Limitations of surgery in cancer of breast. We can remove a wide area of superficial tissue conjointly with metastatic spread via channel (*1*) into axilla. Spread via subpleural lymphatics (*2,3 and 4*), opposite mediastinum (*6*), abdomen (*10,11 and 12*) and supraclavicular region (*14*) are hopeless. Spread to upper axilla (*13*) and homologous mediastinum (*5*) are dubious as regards surgical cure.

From clinical and pathologic observation, it seems doubtful to us that x-ray therapy over the internal mammary chain will accomplish a great deal. Surgical extirpation of mediastinal spread is also still in the experimental stage. We believe that if the disease has involved these nodes, the presumption must be that it already is widespread in the mediastinum.

Spread to the opposite breast and the opposite axilla (Fig. 6, *6,7 and 8*) is well known. Spread to the liver and abdomen (Fig. 6, *10,11 and 12*), often via the round ligament, may already exist and be unsuspected at the time of surgery. Spread to the upper axillary region, close to the axillary vein (Fig. 6, *13*), is very serious, and spread to the supraclavicular fossa (Fig. 6, *14*) was ruled out as amenable to surgery by Halsted fifty years ago.

The extreme variation in the biology of cancer—why one patient will die despite early and radical treatment and another remain well after limited treatment—is well shown in any series of cases of cancer of the breast which have been personally followed up for a long time.

The following case will serve as a contrast to Cases XI and XII.

CASE XIII.* In this patient local recurrence occurred six, ten and twenty years after the original incomplete operation. As yet (twenty-three years later), there is no indication of systemic metastases.

CANCER OF THE BREAST IN THE AGED

These slow-growing types of cancer, which often remain dormant after what is considered incomplete removal are especially common in the aged. Many elderly women with cancer of the breast do not have to undergo a thoroughgoing radical procedure.

Another problem in these aged people is whether or not to remove the breast when there is associated mental deterioration, impending heart failure, hypertension and the like. One cannot predict when such disabilities of old age will stabilize, enabling the patient to live in relative comfort for a number of years. Therefore, it is not proper to deny the patient surgery because the presumed length of life might not warrant removing the malignancy in the breast.

CASE XIV. A sixty-one year old woman had been mentally deteriorated for a year before surgery and rapidly seemed to be becoming senile. She had emotional lability, had not been interested in anything for the past year and could not be trusted outdoors. Six years after modified radical mastectomy her mental condition seemed to improve. She resumed her daily routine, kept house, and eight years postoperatively was apparently living a normal life. Ten years after operation mental deterioration again set in.

* Previously reported as Case IV [6].

TABLE VIII
MISCELLANEOUS TYPES OF CANCER

Type of Cancer	Total No. of Patients	No. Traced	Patients Living Three or More Years after Surgery		Total No. of Patients	No. Traced	Patients Living Five or More Years after Surgery	
			No.	Per cent			No.	Per cent
Basal cell, skin	13	12	7	54	8	7	6	75
Squamous cell, skin	15	12	8	53	9	7	4	44
Melanoma	11	11	8	73	7	7	4	57
Lymphoma	17	15	4	24	11	10	2	18
Others	18	17	9	50	13	12	1	54
Primary tumor unknown	27	27	3	11	23	23	1	4
Totals	101	94	39	39	71	66	24	34

Heart failure or hypertension can likewise adjust and stabilize, and the patient can live indefinitely in relative comfort.

We have had four cases in which a solitary mass of varying extent involved the bony cage of the chest wall, and wide local excision of this portion of the ribs or sternum was performed. In three of these patients the local area stayed free of disease but the mediastinal and pleural spread continued. The fourth patient (local recurrence in the chest wall removed by Dr. Wm. Tuttle) has remained well for fourteen months.

Such cases represent unusually slow-growing types of cancer. When a local recurrence invades the bony chest wall to any great extent, the disease presumably is already in the mediastinum and in most cases will progress.

MISCELLANEOUS TYPES OF CANCER: MELANOMAS

Melanomas are the most unpredictable tumors we treat. (Table VIII.) Of eleven patients, five have died. One had had an eye removed elsewhere and was well for five years; then metastasis of the right rib margin developed followed shortly by intra-abdominal and liver metastasis from which the patient died in six months. Another patient had had a melanoma of the left thigh removed elsewhere six years before. This patient was well for four and a half years, then died of local and intra-abdominal recurrence in sixteen months.

A third patient had a melanoma on the left anterior thigh 2 inches above the patella. Wide local excision of a melanoma was performed followed by skin grafting. Radical inguinal node dissection on the left side was done at the same time. The nodes were negative. The patient was perfectly well for three years, and then headache and rapid generalized metastases suddenly developed from which he died in five weeks. There was no further disease in the groin or the local site.

A fourth patient had a retroperitoneal tumor, the diagnosis of which was somewhat in doubt; the total illness lasted five months.

The fifth patient had a rather extensive melanoma of the anus for which we performed a variety of operations, including abdominoperineal resection and bilateral inguinal node dissection, then local excision of multiple skin metastases. He died two years after the onset of the symptoms; as near as we could judge critically, the multiple operations had not altered the course of the disease to any appreciable extent.

Of those patients who have remained well, one underwent wide excision of a melanoma on the left calf which had been present for ten years and had become larger during the past year. She has been well for five years without any sign of recurrence. A second patient had a melanoma of the coccyx excised locally in the office by us. The pathologist said the excision was not wide enough so a wider local excision was performed. She has remained well for twelve years with nothing further having been done. The third patient had a melanoma of the umbilicus which was excised locally. She has

been well for five years. The fourth patient had a similar melanoma in the back, mid-scapular region and has stayed well for more than three years following wide excision and plastic closure. The fifth patient had a melanoma of the toe which had been treated for two years by a chiropodist. Local amputation of the first toe was performed and inguinal node dissection was done two weeks later. She is well six years later with some disability from moderate edema of the leg. The sixth patient had a melanoma of the right postscapular region superimposed on a mole which had been present since birth. Local excision was performed, followed by axillary node dissection in continuity six weeks later. She has been well for five years.

The impressions this small series have left are as follows: (1) General metastasis might develop years after local excision, which is well known. When it does, it often seems to be blood-borne and death follows rapidly. (2) The patients who have stayed well have undergone wide local excision. (3) It is very difficult to assess the value of inguinal node dissections.

UNKNOWN PRIMARY ORIGIN OF TUMOR

In twenty-seven cases, the primary origin of the tumor was unknown. (Table VIII.) Neck nodes were involved in seven. In these, the primary site was usually thought to be below the clavicle, but a few were suspicious of an intraoral primary site. In two cases, the malignancy was in the chest and the primary site was unknown. In thirteen cases, the abdomen was involved and the primary site was unknown. Six patients had liver involvement, two had retroperitoneal masses and five had generalized abdominal carcinomatosis, some with ascites, suspicious of pelvic origin, but the primary site could not be determined. In the remaining five patients the tumors were miscellaneous and unclassified. This is about what one would expect to find in any large series. It is not expedient to explore most of these patients in order to find the primary focus. In a very exceptional case, however, it may be worth while to resect the tumor even though the primary site is unknown [7].

PATHOLOGIC DIAGNOSIS

In this miscellaneous group there are three cases in which, because of unusual circumstances, consultation was sought from several nationally known centers. In spite of dire predictions and confusion in pathologic interpretation, each of these three patients has lived beyond the ten-year period. Two had soft tissue tumors and one a sarcoma of the femur. The lesson is that the clinician's responsibility cannot be transferred to the pathologist's typewritten report. The latter "sees only six microns of tissue," usually is unfamiliar with the clinical course and objective signs, and is not responsible for the follow-up care.

CASE XV. L. E., at the age of six months, had a small pinhead-sized lump in the posterior scalp just to the right of the midline. It grew very slowly. When the patient was two, it was removed in a doctor's office. No specimen was examined. Within two weeks there was a small lump palpable just to the side of the scar.

When first seen (at the age of three) there was a 1½ inch subcutaneous swelling in the occipital region of the scalp. It was movable underneath the skin, well circumscribed, soft, somewhat tender and not attached to the periosteum. It was removed on April 19, 1941. Three months later another nodule was noted ½ cm. lateral to the scar. This was the fourth recurrence. Pathologic opinions from local and well known national authorities were as follows (Fig. 7A): (1) Locally malignant neoplasm, may be metastatic; somewhat resembles adrenal tumor. Diagnosis: poorly differentiated chordoma. (2) Rhabdomyosarcoma. (3) Not a tumor, but lipoid histiocytosis. Specimen contains membraneous bone. (4) Histiocytosis, not a tumor. (5) Large round cell sarcoma.

In November, 1941, the entire area was excised very widely and a large split-thickness skin graft applied. The periosteum was not involved in the tumor. The patient has remained well and has been followed up periodically. When she was last seen (January, 1955, fourteen years later), she felt well, had grown into a young adult and had no evidence of recurrence. There is a large skin-grafted area on the posterior scalp over which her hair falls easily. (Fig. 7B.)

CASE XVI. L. M., a thirteen year old girl, was first seen on December 23, 1940. A small lump had been noted on the external surface of the right thigh four or five months previously. It had not increased in size. It was bruised two days before and had been tender since. Exami-

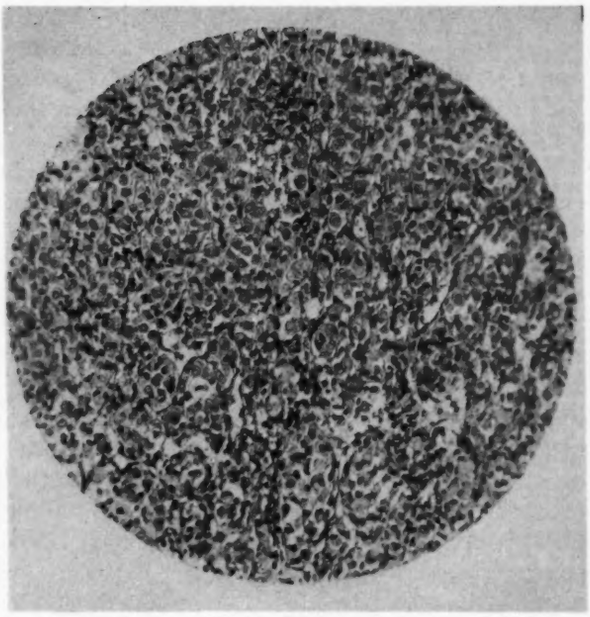

FIG. 7A. Case XV. Photomicrograph of original lesion. The following pathologic opinions were given by local and nationally know authorities: (1) rhabdomyosarcoma, (2) lipoid histiocytosis, and (3) round cell sarcoma (large).

FIG. 7B. Case XV. Confusion in pathologic interpretation. Lump on post-scalp; onset, age of six months. Repeated local removal at the age of two and a half, three, and three and a half, then wide excision of entire area with skin graft. Photograph shows result fourteen years later.

nation showed a tense tumor below the region of the right trochanter. Through a transverse 2 inch incision, 1 inch below the right trochanter, a deeply pigmented cystic mass was excised. It was subcutaneous and was excised down to the overlying fascia. It did not involve the fascia. Gross appearance was a "shell filled with inspissated blood." Pathologic interpretations were as follows: (1) "Very malignant large cell medullary tumor, probably a myogenic sarcoma but possibly a metastatic carcinoma." (2) "Grade 4 hemorrhagic malignant neoplasm with involvement of the lymph node. We have explained the seriousness of a grade 4 neoplasm to the father. The prognosis is not good. A series of x-ray treatments were given." (3) "High degree of malignancy. Bursal lesion. Wide excision of the former operative site is indicated and the condition is not necessarily hopeless." (4) "Old vascular lesion which has undergone metaplasia to a sarcomatous type. I would not advise further surgical intervention nor x-ray treatment unless there should be evidence of recurrence." (5) "Angiosarcoma. I would expect it to behave clinically in a benign fashion. Nothing further should be done. I advise close follow-up rather than wider excision or radiation. There might be a primary lesion somewhere else of which this might be a metastasis. Ninety chances out of 100 that this will behave as a purely local lesion. Sixty chances out of 100 that it will not recur locally."

In view of all this conflicting advice, nothing further was done. In February, 1955, fourteen years after the operation, she had been married seven years and had two children. There is a faintly visible, well healed transverse scar below the right trochanter. (Fig. 8.) There is no further evidence of disease.

CASE XVII. This eighteen year old boy, when first seen by the senior author in February, 1944, had osteogenic sarcoma of the right femur of four months' duration. A biopsy specimen was removed from the tumor in the right femur, below the trochanter. The pathologic interpretations were as follows: (1) "Fibrochondro-sarcoma, low grade malignancy. Will recur locally if not all removed. Will be more malignant at successive recurrences but will not metastasize at this time." (2) "Spindle cell osteo-chondrogenic sarcoma. Advise high amputation." (3) "Grade 2 osteogenic sarcoma. High amputation followed by x-ray." (4) "Malignant osteogenic tumor. Advise high amputation but this offers not more than

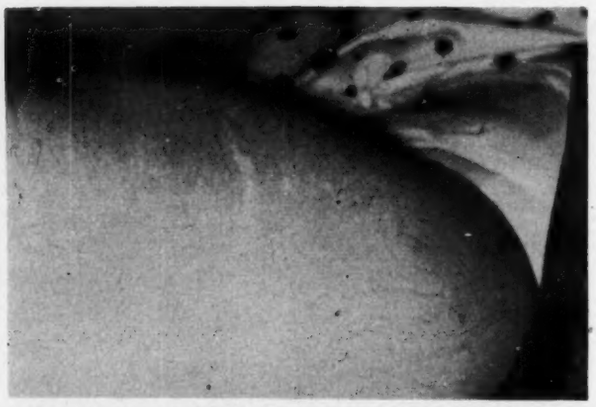

FIG. 8. Case XVI. At thirteen, lesion of bursa over right trochanter was removed locally. Pathologic opinions: myogenic sarcoma, malignant neoplasm, grade 4; possibly metastatic; old vascular lesion with sarcomatous metaplasia; angiosarcoma, clinically benign. Nothing further was done. Photograph taken fourteen years postoperatively shows well healed scar. No local recurrence evident.

10 per cent possibility of cure because of high location, extending well up into junction of upper and middle third of the femur." (5) "Do not feel that any treatment is indicated. Agree upon amputation with meager prognosis as to life."

Right hip disarticulation had been performed in May, 1932. The patient has remained well twenty-three years (April, 1955), has married, raised two children and successfully operates an auto repair business.

We have, on occasion, chosen not to follow the pathologist's advice, with all due deference to his knowledge.

CASE XVIII. This forty-three year old woman was first seen by the senior author in May, 1942. Vulvectomy had been performed in New York five years previously for carcinoma. She had a small local recurrence in the vagina near the right Bartholin gland. This was treated with radium, locally excised and has remained well. The patient also had a hyperplastic area of skin at the anal margin which on excision proved to be squamous cell carcinoma. She weighed 200 pounds and was about 5 feet, 1 inch in height. She was crippled with arthritis; her right leg was stiff and ankylosed in a 20 degree forward position. She pleaded not to have a colostomy. The local lesion on the anal margin was excised. It was decided to wait and observe what happened. We have in our records the dates of fifteen local excisions or biopsies of anal hyperplastic skin areas (the last in March, 1954). Seven diagnoses of squamous cell carcinoma were given as: "early," "*in situ*," "grade 2" and "grade 3." In eight other instances the following diagnoses were given: "leukoplakia," "keratotic papilloma," "keratinization," "chronic inflammation" and "no disease." Six different pathologists' names are signed to these reports. The patient comes to the office every few months (last examination in May, 1955). If an area becomes hyperplastic and irritated, it is excised under local anesthesia. The anal margin is scarred but it is soft, pliable and functions perfectly. (Fig. 9.) Our opinion has been that the clinical appearance of the aforementioned lesion is more characteristic than the microscopic picture, and over the course of thirteen years this judgment has been substantiated.

We have had similar experiences with intraoral lesions, as demonstrated in the following case.

CASE XIX. In this fifty-six year old man, a biopsy specimen of a lesion on the vermilion border of the right angle of the mouth (November, 1948) revealed grade 2 squamous carcinoma. Local excision, Y-shaped, with plastic closure was performed. The specimen showed no further invasive cancer. The patient has remained well for seven years. (Fig. 10.)

THE CALCULATED RISK IN CANCER SURGERY

Each time a malignant tumor is removed, there is the potential risk of traumatizing the tumor or cutting through the lymphatics at their peripheral drainage areas. Both maneuvers may spread the disease. This can only be considered a calculated risk. Cole [9] has made a contribution which has gained immediate acceptance in his directive that, when operating for carcinoma of the colon, the lumen of the bowel should be tied off before being manipulated, and the vessels at the base of the mesentery should be exposed and ligated at the start of the dissection. There is real danger of live cancer cells escaping by manipulation of the bowel. Garlock [10] has expressed a similar warning. If a carcinoma of the colon has invaded the serosa, one should immediately place a gauze sponge over it to avoid transplantation of cells during surgery. We have had this experience.

FIG. 9. Case XVIII. Recurring locally malignant lesion of anus. Fifteen local excisions were performed over a period of twelve years. Seven diagnoses of cancer were made: *in situ*, early, grade 1, grade 2. In eight other instances the diagnoses were leukoplakia, keratotic papilloma and no disease. Reports were rendered by six different pathologists. Photograph shows anus and lower post-vagina after thirteen years' observation. Scarring from multiple excisions is present, but anus is soft, supple and functionally competent.

CASE XX. This thirty-seven year old man had carcinoma of the sigmoid colon which was adherent to the posterior wall of the bladder. Just as the growth was about to be separated from the bladder, he went into cardiac arrest and the operation was terminated. Two weeks later it was resumed. The tumor had invaded the serosa of the bowel and was densely adherent to the bladder. This was dissected away. A small biopsy specimen taken from the posterior wall of the bladder showed a few carcinoma cells. After another four-week wait, the abdomen was reopened for a "second look" to be certain there was no residual carcinoma in the wall of the bladder. The site of the previous attachment was negative, but to our surprise, the deep pelvis and a neighboring loop of small bowel was studded and seeded with minute areas of metastatic carcinoma.

The same catastrophe can occur in the breast (Case XI, Fig. 5). Neck dissection can also spread carcinoma.

CASE XXI. I. W., a seventy-one year old man, had an ulcerating lesion on the anterior floor of mouth of three months' duration. Wide local excision was performed on September 9, 1954. Right radical neck dissection was accomplished on September 8, 1954. In February, 1955, multiple skin and subcutaneous nodules developed in left side of neck. (Fig. 11.) These progressed rapidly down the front and back of the chest wall to the mid-trunk, and similar nodules appeared in the scalp. He died on March 18, 1955, six months after right radical neck dissection. Total duration of the disease was nine months.

GENERAL OBSERVATIONS

In general, the more slowly growing cancers can be cured. The large, fungating, polypoid, excrescent mass, which seems to expand its energy growing outward, has a better prognosis than the small ulcer which is infiltrating and goes rapidly into the metastatic lymph channels. Also, in spite of some statements, our personal experience leads us to believe that tumors in the older age groups are more easily cured than those in younger patients. We are not certain whether or not cancer of the breast is an exception.

The reason the duration of illness before treatment is not always a good prognostic sign is because the slowly growing types of cancer may be cured when treated one or two

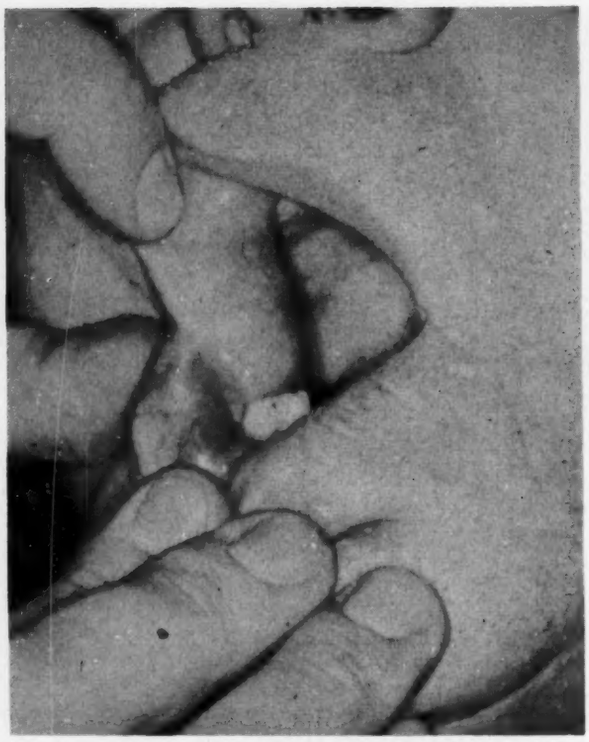

FIG. 10. Case XIX. Biopsy specimen of lesion at right angle of mouth on vermilion border showed squamous carcinoma, grade 2. Local excision only. Patient well for seven years.

years after onset; other types treated within a month or two after having been discovered are hopeless.

Cancer varies tremendously in its potentialities for growth. We have only vague knowledge of the body defense against cancer. There are a few cases on record in which a growth, after having been present for as many as three, four or five years, suddenly and spontaneously disappeared. Also, a good deal depends on the active lymphatic drainage of the site involved. For instance, the stomach is an actively secreting and digesting organ; it has a profuse blood supply, rapid lymphatic absorption and nodes immediately adjacent which often are inaccessible. The prognosis for gastric cancer is poor, whereas in the colon, nature has attempted to limit the lymphatic drainage and, therefore, cancer of the colon has a much better prognosis. An actively moving organ, such as the tongue, shows a poor prognosis for cancer when compared with the lip.

The optimum benefit from surgery for cancer will be obtained when the very rapidly growing types, in which cure is minimal, are avoided, and, when the chance of cure is

FIG. 11. Case XXI. Seventy-one year old man. Ulcerating lesion on anterior floor of mouth. Photograph shows local recurrence three months after radical neck dissection. Subcutaneous metastatic nodules spread over anterior and posterior chest wall to mid-trunk and to scalp; patient died six weeks later.

favorable a wide thoroughgoing operation is performed. In addition, a large group may be cured by less radical measures. The trouble is that we only have percentage figures to gauge our results. These gross estimates are subject to many clinical exceptions when considering the curability of one particular case. The case reports in the body of the paper illustrate this. The choice lies between: (1) unnecessary surgery, (2) "meddlesome" surgery which has very little chance of benefit, (3) radical surgery which is curative in a high percentage of cases, and (4) limited surgery which is adequate for the particular patient.

The statistical guideposts of others are not always sufficient. Prognostic judgment is helped immeasurably by a follow-up of one's own personally treated cases. This choice is not easy, and it often is an individual matter for each surgeon.*

* Handley, after a critical review of 150 internal mammary node biopsies, and an attempt to discern "whither the facts are leading in the realm of treatment" had this to say as his final conclusion: "The problem of carcinoma of the breast holds many imponderable factors. We cannot yet assess with much accuracy the malignancy of tumors, and we know almost nothing about host resistance to their spread. Until the biochemistry of tumor growth and host-resistance is better understood we can only grope by mechanical means along therapeutic paths which are dimly indicated by morbid histology and judge by the slow criterion of the end-result whether the technique we follow is better (or worse) than its predecessor" [*11*].

SUMMARY

1. A follow-up is presented of 572 patients with cancer who were personally treated and followed up. By body regions there are: 96 in oral cavity; 36 primary in the neck; 180 in the abdomen; 38 in the pelvis; 122 in the breast; and 101 miscellaneous. The follow-up is 92.8 per cent complete for three years and 91 per cent complete for five years. Thirty-five per cent of the cases have been followed up ten years or more; 47 per cent have been followed up five years, and 18 per cent have been followed up three years.

2. Cancer is becoming an ever-increasing therapeutic problem in all general hospitals.

3. The statistical data on patients with cancer of the head and neck is not large, but the experience warrants certain opinions which are stated. There is necessity for individualization in the treatment of these cases. The potential metastatic spread may be unpredictable.

4. Three-year "cures" for cancer of the stomach were 5 per cent (sixty cases). Five-year "cures" were 2 per cent (forty-four cases). Three- and five-year "cures" for cancer of the pancreas and gallbladder were zero.

5. Five-year "cures" for cancer of the colon were 44 per cent (fifty-four cases), and for the rectum, 35 per cent (twenty cases).

6. In 122 cases of cancer of the breast, three- and five-year "cures" show about the same results when axillary nodes are not involved: 76 and 78 per cent, respectively. When the axilla was involved, three-year "cures" were 48 per cent, five-year "cures" 39 per cent.

7. Melanomas likewise are very unpredictable. In a very small series, extensive wide local excision seems to be the most important factor in cure.

8. The pathologist's opinion is not "sacrosanct," and must continually be measured against the clinical manifestations and course in each case.

9. Any operation for cancer carries the risk of cutting through lymphatics or traumatizing the tumor by our own manipulations, thereby spreading the disease.

10. A plea is made for the personal follow-up of all patients with cancer who have received treatment.

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Cancer and the Reluctant Surgeon

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DESPITE recent advances in surgical technics, anesthesia and related services which have widened the scope and practicability of cancer surgery tremendously, there generally appears among some surgeons today an attitude of ready discouragement when confronted with patients who have an extending or recurrent cancer; there is a willingness to be dissuaded from attempting "curative procedures" and a backing away from responsibility in the postoperative management of patients with malignant disease. Along with the enthusiasm generated by a limited but brilliant group of surgeons for the use of multiple, repetitive and radical procedures[1] in the treatment of cancer have crept the nagging doubts of others who regard these surgeons as meddlesome; who shrink from performing any but the most limited resections; who are readily persuaded that a patient's condition is inoperable or that surgery is contraindicated and who have supplanted a dynamic attitude of "doing the most good" for the patient with cancer by an inert one of "doing the least harm."

There are, unfortunately, many factors responsible for this attitude of inertia. Principal among them is the lack of a marked increase in the survival rates of patients with certain common types of cancer in spite of the utilization of improved or extended technics.[2] In particular, survival rates of patients with cancer of the stomach, lung, prostate, pancreas or lymphopoietic system have shown little or no increase, while survival rates of patients with cancer of the breast, colon and rectum, female genitalia, head or neck have recently shown moderate increases. In every series it is noted that the highest survival rates for the longest periods attend those patients in whom cancer is detected "early" or localized at the time of initial therapy. This factor seems more important than the technic of treatment, providing scope is adequate. Thus, the lack of an increase in survival rates reflects not so much on failure of improved technics as on the inability to detect early lesions. In patients with recurrent or extending cancer, survival rates are meaningless. Each case must be clinically appraised and a comparison made with an imaginary outcome had surgery been withheld. This defies statistical analysis but it does not remove the surgeon's responsibility for placing his patients with cancer in the group of those favorably palliated, if possible.

The age of the patient is frequently an excuse to refrain from undertaking extensive surgery, the plea being made that the patient may die or that the expected survival period is all too brief to justify expenditure of much time and effort. Such is not the experience of those dealing with this group who find that octogenarians survive major surgery very well[3,4] probably because, as Martin says, their very survival to this age alone "might be taken as fairly conclusive proof of a certain physical toughness of fiber not inherent in those who die at younger ages."[5] The following case will illustrate this point.

CASE 1. A. K., an eighty-one year old white man, experienced loss of weight for two years which he attributed to eating only soft foods after having all his teeth removed. For two days, however, he had difficulty swallowing liquids. Because of this, a barium swallow examination at the Woman's Medical College Hospital was performed. A lesion was noted in the upper third of the esophagus and biopsy by esophagoscopy revealed squamous cell carcinoma. The patient's general physical condition was good and on June 6, 1950, esophagec-

tomy with anastomosis of the stomach to the remnant of esophagus was performed. The patient made a good recovery. No evidence of recurrence was noted five years and five months later (December, 1955). No disability has resulted from the thoracic stomach.

Evidence of recurrence or metastasis before surgery may convince a surgeon not to operate on some patients with cancer who, because of the nature of their lesions, may still be in an operable or even curable stage. Likewise, the suspicion of metastasis must be verified, lest benign and unrelated disorders be mistaken for malignant growth. The following case will illustrate this point.

Case II. In a nearby town, patient P. A. had undergone resection with primary anastomosis for carcinoma of the sigmoid colon at fifty-three years of age. Exploration at the time showed no evidence of metastasis. Two months later rectal bleeding occurred and after further delay of three months he was admitted to the Woman's Medical College Hospital where a biopsy specimen of the rectum showed recurrent adenocarcinoma. A draining sinus tract which led from the abdominal scar into the sigmoid was also observed. On January 13, 1953, the rectosigmoid and adherent terminal ileum were resected and the peritoneal covering of the lateral pelvic wall was removed; a second end-to-end anastomosis was performed. It was noted that the tumor recurred only in the rectosigmoid, the remaining tissue showed only abscess formation and inflammation. The patient made a good recovery and no symptoms indicating recurrence had been noted three years later (January, 1956). This case illustrates the value of making an attempt to cure a patient in whom previous surgery had been unsuccessful.

Case III. L. B., a seventy year old man, had undergone resection for carcinoma of the rectosigmoid in 1952 at the Graduate Hospital in Philadelphia. Thereafter, an incisional hernia developed, and two years later the patient was admitted to the Woman's Medical College Hospital for its repair. On August 10, 1954, when repair of the hernia was made, it was observed that the omentum and peritoneum contained multiple tumor implants. The omentum was resected; both it and the peritoneal sac contained nodules of mucoid adenocarcinoma. When seen thirteen months later (September, 1955) the patient had almost no increase in symptoms. He continued his business as a clothing merchant but was having occasional symptoms which suggested impending bowel obstruction.

We present this case as one in which resection of the omentum, widely infiltrated with carcinoma, has apparently resulted in slowing the process of peritoneal spread. Whether we are justified in this assumption is debatable.

Case IV. E. A., a thirty-seven year old woman, was noted to have a lesion of the ascending colon in November, 1953. The patient had had lower abdominal symptoms for a year, during which time two spontaneous abortions had occurred. Laparotomy revealed adenocarcinoma of the ascending colon with extension to regional nodes and diffuse liver metastasis. Wide resection of the right colon and terminal ileum was performed with ileo-ascending colostomy. In September, 1954, ten months later, the patient became pregnant and a therapeutic abortion was considered but declined. Subsequently, she gave birth to a six and a half months premature child who survived. The patient's condition at delivery was good in spite of the extent of the disease. She lived comfortably for eleven months after the birth of her child; only in the last month did jaundice and hepatic failure develop.

This case is presented as evidence that it is worth trying to help a cancer patient surgically even in the face of seemingly insurmountable odds. By removal of the primary growth, this patient was relieved of obstructive symptoms and lived a relatively normal life for two years, sustaining pregnancy and delivery before liver metastases caused her death.

The site of a lesion and its customary natural history may cause a surgeon to refrain from attempting complete removal or, indeed, from attacking it at all. This is particularly true of lesions of the esophagus, stomach, lung, liver and prostate, certain oral lesions, bone tumors and melanomas. Likewise, a histologically undifferentiated or highly graded tumor carries with it, like an aura, a concept of clinical behavior which is not always justified. New information must be acquired by surgeons regarding the relation of histology to clinical behavior, and careful observation of the re-

ports of others regarding variability in tumor behavior must guide them in approaching each particular case. It is not possible to categorize tumors and withhold or administer therapy accordingly, for each presents an individual problem.

CASE V. J. B., a seventy-five year old Negro man, noted loss of weight and indigestion for six months, and pain culminating in vomiting and tarry stools for three weeks. Studies at the Woman's Medical College Hospital revealed an obstructing lesion of the pylorus of the stomach and a moderately severe anemia. After the latter was corrected laparotomy was performed on August 17, 1954. Resection was then carried out for carcinoma involving the distal third of the stomach with extension to the gastrocolic and gastrohepatic ligaments and adjacent lymph nodes. The liver was free of metastasis. The patient made an uneventful recovery and has resumed work. No evidence of recurrence was noted sixteen months later (December, 1955).

CASE VI. J. M., a fifty-four year old Negro man, had noted loss of weight for a year. When seen at the Woman's Medical College Hospital Clinic, he had a palpable epigastric mass. A barium meal study revealed a lesion in the distal stomach and on January 24, 1954, high radical gastrectomy and a Hofmeister procedure were performed for an antral gastric lesion with extension to adjacent lymph nodes. Postoperatively, thrombophlebitis of both legs developed, but otherwise the patient remained well for twenty-three months (December, 1955) and resumed work.

CASE VII. P. C., a sixty-one year old man, had a three-month history of abdominal pain. On examination, occult blood was noted in his stool. Gastrointestinal study revealed a gastric lesion, and on March 28, 1954 (at the Woman's Medical College Hospital) a 90 per cent subtotal gastrectomy with postcolic Polya gastrojejunostomy was performed. Examination revealed adenocarcinoma of the mid-body of the stomach, lesser curvature, extending to the gastroesophageal junction with extension to regional nodes. The patient has remained well and worked daily without evidence of recurrence for twenty-one months (December, 1955) but has been unable to regain his former weight.

These three patients with carcinoma of the stomach treated by resection, in spite of evidence of widespread gastric involvement and lymphatic extension, illustrate that in many instances a useful life may be expected well into the second year after operation. Radical resection is therefore justified if the operative risk is not prohibitive and if the outcome, in terms of nutrition, is compatible with normal life, even though the results of surgery for gastric cancer, in general, are known to be poor.

Apparent disability of a patient with cancer and the presence of intercurrent disease, especially in the elderly, may sometimes be the sole criteria for failure to perform curative surgery. Too often the surgeon blames the family physician or internist for not getting a patient "into shape" for surgery; while much time is spent trying to replace proteins and correct anemia or dehydration due to the presence of a tumor or its complications, the lesion is progressing and soon a totally inoperable state is reached. Obviously, the disabilities of a patient must be corrected as much as possible and diabetes, intercurrent infections and the like must be brought under good control; otherwise surgery is hazardous. However, a delay of more than two or three weeks in correcting these disabilities seldoms seems justifiable. In no case can one assume that time is not of the essence despite evidence that the longest growing tumors have the best prognosis.[6]

An exception to the need for prompt surgery is the patient with serious cardiac, renal, hepatic or respiratory insufficiency in whom a surgical procedure for any reason would be exceedingly hazardous. Here, very thoughtful consultation between the internist, anesthesiologist and surgeon is necessary and the final decision is seldom easy to make. With the advantage of a skilled anesthetist and a quick, efficient surgeon, a poor risk patient may tolerate surgery; however, the lethal nature of untreated cancer should not be used as justification for operating on moribund or rapidly deteriorating patients unless real relief and improvement can be expected. When it can, the proposed surgical procedure should then assume the same statute as any other corrective emergency surgery.

CASE VIII. I. B., a sixty-seven year old woman with diabetes, hypertension and arterio-

sclerotic heart disease, was admitted to the Woman's Medical College Hospital in cardiac failure in October, 1953. After compensation the patient was studied because of increasing constipation, and an infiltrating lesion in the sigmoid colon was found. Routine preoperative electrocardiogram disclosed that an acute myocardial infarction had occurred, presumably coincident with the onset of cardiac failure. Follow-up tracings showed satisfactory progression, and five weeks after admission adenocarcinoma of the sigmoid colon with lymph node metastasis was resected and primary anastomosis performed. The patient made a good recovery and, except for an episode of congestive failure and precordial pain a year later, has remained comfortable. No evidence of recurrence was noted twenty-six months after surgery (December, 1955). This case illustrates that the risk of surgery is justified for malignancy even in the presence of other serious disease.

Good postoperative care of cancer patients, unlike that of those with self-limited surgical conditions, entails periodic follow-up for the balance of the patient's life. Distaste for this type of office procedure is responsible for the recurrence or metastasis in many patients with cancer who might be treated curatively or at least palliatively if symptoms were noted soon after onset. A surgeon should eagerly accept this responsibility if it is indicated, for only by a follow-up of his own patients can his technics be properly evaluated and a basis formed for judging the work of other surgeons. Percentage of cure or recurrence rates are no more reliable than the percentage of cases on which they are based.

Case ix. M. K., a sixty-two-year old woman, had had resection for carcinoma of the sigmoid colon with primary anastomosis on August 9, 1951. Five months later vaginal bleeding led to the discovery of residual tumor involving the anterior vaginal wall and the floor of the bladder. This was resected. Eight months later a new mass appeared in the same site and the bladder, urethra, vagina and distal ureters were resected; the ureters were transplanted into the sigmoid above the original anastomosis (which was free of recurrence). Five months later a small area of recurrence in the vaginal stump appeared and was controlled with electrocoagulation over the next month. A rectovaginal fistula developed therefrom but was closed successfully with no evidence of residual tumor. Two years later, fifty-one months after the original diagnosis was made and forty-six months after the onset of recurrence, the patient is alive and well. There is no evidence of recurrence and the patient has only minimal difficulty from the ureteral implantations (December, 1955). This case illustrates the importance of a careful follow-up and of therapy to relieve symptoms and signs of recurrence as they develop. It seems apparent from clinical experience that rectal and rectosigmoidal carcinoma recurring locally seldom produces distant metastasis. It is unfortunately true, however, that recurrent tumor cannot always be completely removed as it seems to have been in this case. When the recurrence is in tissue that can be removed or destroyed, it is worthwhile to attempt such removal as often as necessary. In this case three recurrences were treated with an eventual successful result.

Blame for failure to cure by an operative procedure should never deter a surgeon from undertaking an operation if he believes it is within his scope and the criteria for operability are met. Because of the nature of cancer and the inability at present to detect with accuracy the tissue limitation of a tumor or the presence of unrecognized distant metastasis, and because of our inability to understand other factors which govern rapid recurrence and progression despite apparent operability, it is inevitable that among a surgeon's patients with cancer there will be all too many in whom the outcome is unfavorable despite early, inclusive, meticulous surgery and careful follow-up. For each of the cases presented herein in which response to treatment seems favorable, many others of similar proportions, but with rapid death, could be cited. Until we understand the true pathogenesis of cancer, we must treat it on all levels to the best of our knowledge, hoping in each case for a cure and facing recurrences, metastases and final inoperability as calmly as we face the ravages of other incurable but more chronic disease states.

SUMMARY

Factors influencing some surgeons to withhold surgery in extending or recurrent cancer

are reviewed, and an analysis of each is made with illustrative examples. These include: (1) lack of increase in survival rates with improved surgical technics; (2) advanced age of the patient; (3) evidence of recurrence or metastasis; (4) the natural history and histopathologic grade of a tumor; (5) apparent disability of certain patients and the presence of intercurrent disease; (6) distaste for careful follow-up examinations; and (7) possible blame for failure to cure.

An attitude of attempting to do the most good for patients with cancer rather than the least harm is urged.

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Local Analgesia: Head and Neck. By Sir Robert MacIntosh, D.M., F.R.C.S (Edin.), F.A.R.C.S., M.D. (hon. causa); and Mary Ostleree, M.B., M.R.C.P.E., F.F.A.R.C.S. Illustrated by Marjorie Beck. 138 pages, with 145 figures, some in color. Baltimore, 1955. The Williams & Wilkins Co. *Price* $6.50.

Clinical Experiences in the Surgical Treatment of 143 Patients with Patent Ductus Arteriosus

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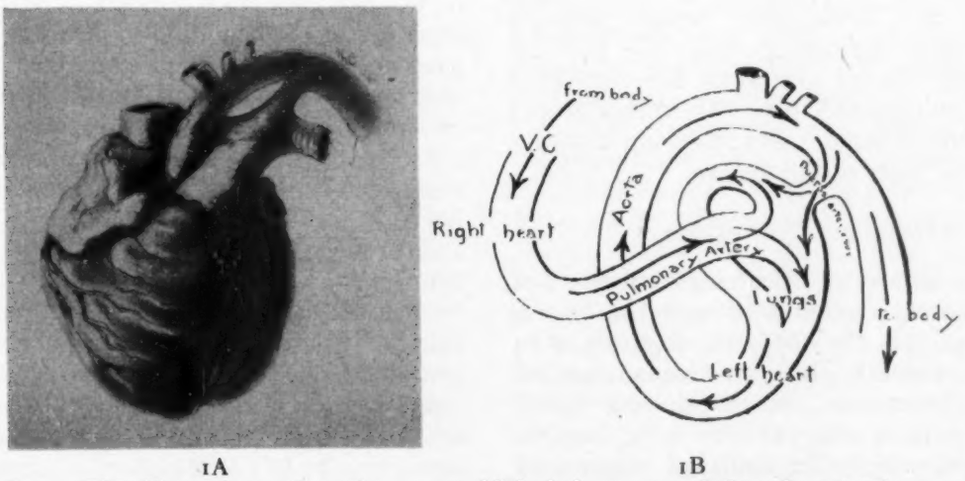
As early as 1907, Munro of Boston [1] described his observations in a group of patients with cardiac disability due to a patent ductus arteriosus. He made the following prophetic statement, "its ligation must be followed by instant and permanent restoration of the lungs and heart to a normal function." In 1927, Cutler and Beck [2] wrote, "it seems reasonable to assume that if this communication were ligated at operation, the heart would be relieved of the handicap. Technical ligation of this persisting anomaly should not be difficult." These surgeons tried to secure patients for operation but were not successful. Figure 1 is the original illustration which accompanied their article. It is evident that surgeons have considered closure of the patent ductus for a long time before the actual performance of the operation. (Fig. 1.)

The first attempt to ligate a patent ductus was reported by Graybiel, Strieder and Boyer [3]. On March 16, 1937, the operation was performed on a patient with subacute bacterial endocarditis due to Streptococcus viridans. Because of technical difficulties during the operation, the ductus was closed only partially with plicating sutures. The patient died on the fourth postoperative day due to acute gastric dilatation. Autopsy revealed that the pulmonary artery contained numerous soft, friable, endothelial vegetations.



1A 1B

FIG. 1. This illustration and caption were published eleven years before the operation was actually performed. A, drawing of the heart of a three day old child, illustrating the patent ductus arteriosus. Ligation of a patent ductus arteriosus is proposed for the relief of cases uncomplicated by other congenital anomalies. B, sketch of the circulation showing the short circuit of blood through the patent ductus arteriosus. (From: CUTLER, E. C. and BECK, C. S. [2].)

The next patient to be selected for operation was a seven year old girl with early cardiac failure. She was operated upon successfully by Dr. Robert Gross of Boston in August, 1938 [4]. Since then, several thousand similarly successful operations have been performed by many surgeons in different centers. The demonstration of the fact that this congenital anomaly can be cured by operation was an important stimulus for many investigations into other congenital and acquired cardiovascular abnormalities. Today, there is scarcely any pathologic condition of the heart and great vessels which is beyond the scope of possible correction by operation.

TABLE 1
SEX, AGE AND RACIAL DISTRIBUTION

Distribution	No. of Cases	Per cent
Sex:		
Female	96	67.1
Male	47	32.9
Age (yr.):		
0–10	89	62.2
10–20	25	17.5
20–30	19	13.3
30–40	10	7.0
Over 40	0	0
Race:		
White	138	96.5
Negro	5	3.5

During the fifteen-year period between August, 1940 and June, 1955, 143 patients with patent ductus arteriosus were operated upon by Dr. Claude S. Beck. These experiences in diagnosis, treatment and follow-up observation are the bases of this report.

DISTRIBUTION OF PATIENTS

Sex. In almost all of the reported series of cases of patent ductus arteriosus the fact is emphasized that the condition is much more common in females. There is no explanation for this sex discrepancy. In the present series, 67.1 per cent of the patients were females. This corresponds to the figure of 70 per cent which was reported by Gross.

Age. The age distribution of the patients is typical of any large group of similar cases. As expected, the majority of operations were performed on children. The youngest patient was four months old. A significant number of patients were in the fourth decade of life at the time of operation. If there were no other contraindications to surgery, age had no influence in the decision to operate. It is a coincidence that the oldest patient was thirty-nine years old. Gross has reported the sectioning of a patent ductus in a fifty-one year old woman, "with great benefit."

Race. The majority of patients were white. The reason for this racial disproportion is unknown. (Table 1.)

DIAGNOSIS

The accurate diagnosis of patent ductus arteriosus is easier to make than that of any other congenital cardiovascular anomaly. Gross has noted that the diagnosis was established by simple clinical examination in more than 95 per cent of his cases.

History. The history is important and should be taken carefully. Precise questioning is necessary in order to evaluate the subtle symptoms of early cardiac failure. In a large number of cases, however, the patient is truly asymptomatic. In this series, 41.3 per cent of the patients had no symptoms. In these cases the presence of a murmur was the only complaint. Operation is safer and easier to perform before the late complications of patent ductus have occurred. Therefore, operation is advised in an asymptomatic patient, when the diagnosis is made.

The histories of all patients were studied for evidence of cardiac failure. Such evidence was present in 42.0 per cent. Fatigue or slight shortness of breath may be the only evidence of early failure. Since these symptoms are improved by closure of the patent ductus, they must be due to the weakness of an overburdened heart.

The physiologic effects of a patent ductus arteriosus are the same as those of an arteriovenous fistula. Large quantities of blood are shunted from the high pressure systemic arterial tree into the low pressure pulmonary vascular bed. This flow has been estimated to be 5 to 19 L. per minute. This results in a strain on the left ventricle which must pump this increased volume of blood. This strain may lead to a high output cardiac failure. The large additional pulmonary inflow may result in pulmonary hypertension with reversal of the shunt flow.

Many children with patent ductus fail to grow and develop normally. This was noted in 22.4 per cent of the patients in this series. The large aortic "run-off" into the pulmonary vascular bed results in a deficient peripheral circulation. This leads to poor somatic development which is particularly evident as a failure to gain weight.

The most serious complication of patent ductus arteriosus is a blood stream infection due to Str. viridans, i.e., subacute bacterial endocarditis. Such an infection was noted in the histories of 4.2 per cent of all patients who underwent operation. In some cases it was present at the time of operation. Abbott reported that more than 25 per cent of the deaths in a series of ninety-two cases of patent ductus were due to this complication. When there is a bacterial endocarditis, there may be friable vegetations on the pulmonic valve. These may extend up the pulmonary artery and through the ductus into the aorta. One of the operative deaths in this series was due to an embolus of bacterial vegetations which occluded a cerebral artery. Prior to the use of antibiotics, surgical closure of a patent ductus was performed as a desperate treatment for subacute bacterial endocarditis. Today, the blood stream is sterilized with the proper antibiotics before operation.

Frequency of respiratory infections was a common complaint. It was noted in the history of 31.5 per cent of the patients studied.

In most cases of patent ductus there is no cyanosis. However, when an infant or child strains or cries, the pulmonary pressure may be elevated markedly. When an open communication is present between the aorta and the pulmonary artery, this elevation of pulmonary pressure may cause a temporary reversal of the shunt flow. In such a situation there is transient cyanosis Episodes of cyanosis were noted in the histories of 10.5 per cent of the patients in the present series.

Physical Examination. Except for the cardiovascular findings, the physical examination of a patient with patent ductus arteriosus may reveal no abnormalities. Evidence of asthenia and poor nutrition was found in 22.4 per cent of the patients in this series. A wide pulse pressure usually is present. This is due principally to a low diastolic pressure. A typical blood pressure reading in a child with a patent ductus is 100/40 mm. Hg. When the ductus is clamped during operation, there is a prompt narrowing of the pulse pressure. None of the patients in this series had clubbing of the fingers or toes. Physical examination revealed cardiac enlargement in 53.8 per cent of the patients who were studied.

The most important factor in the proper diagnosis of patent ductus arteriosus is careful auscultation of the heart. The murmur which is present in this condition is characteristic. Once it has been heard, it is easy to recognize. It is a continuous murmur which is heard throughout the cardiac cycle. There usually is systolic accentuation. The murmur sounds like the rumble of machinery, and is loudest and best heard in the left second intercostal space. Frequently, it radiates to the subclavicular area. P_2 is loud and accentuated. When the ductus is very large, the heart is usually enlarged. The apical thrust may be so forceful that the entire precordium heaves with each heartbeat. In infants under one year of age, the diastolic component of the murmur may be diminished or absent. It is usually present after this time, but may not appear until later. A typical "machinery murmur" was present in 93.0 per cent of the patients in this series. There was a palpable thrill in 80.7 per cent.

Laboratory Studies. Laboratory studies are accessories to the clinical examination. Polycythemia is not present in patients with a patent ductus. The red cell count and hematocrit usually are normal. The prothrombin time, bleeding time and clotting time were determined in almost all of the patients before operation, and were normal.

Cardiac fluoroscopy was performed during the preoperative study of all patients. Cardiac enlargement, which was due to left ventricular hypertrophy, was present in 56.6 per cent of the patients in this series. This enlargement was slight to marked. The pulmonary artery is prominent in an x-ray of a patient with patent ductus arteriosus. There usually is an increase in the pulmonary vascular markings. There may be fluoroscopic evidence of increased pulsations of the pulmonary artery. This is the so-called "hilar dance." A normal x-ray of the chest does not alter a clinical diagnosis of patent ductus arteriosus. However, if there is right ventricular enlargement and decreased pulmonary vascular markings, this diagnosis is questionable. (Fig. 2.)

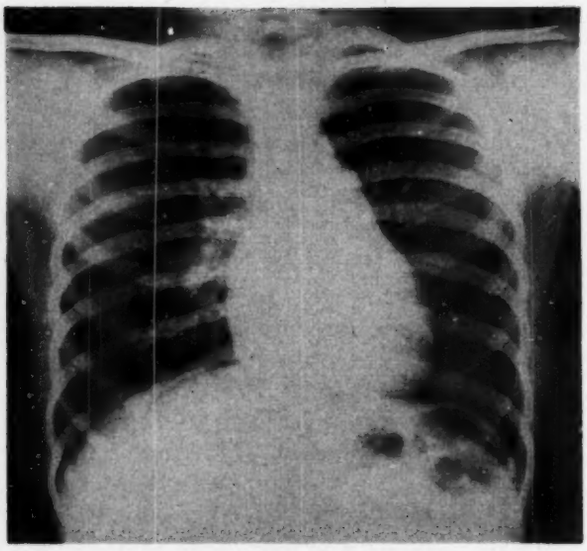


FIG. 2. X-ray of an eight year old girl with patent ductus arteriosus. Note the prominence of the pulmonary artery at the base of the heart. There are increased pulmonary vascular markings.

Electrocardiograms and phonocardiograms were obtained during the preoperative period. There was evidence of left ventricular hypertrophy in 14.0 per cent of the patients studied. High voltage complexes were frequent. Prolonged interventricular conduction time is more favorable for the diagnosis of interventricular septal defect. The phonocardiogram is a good visual record of the auscultation findings. (Fig. 3.)

Cardiac catheterization has been of considerable help in establishing the diagnosis in cases of complicated or atypical patent ductus arteriosus. Since the clinical diagnosis is so accurate, this procedure has been necessary in only twelve patients with a typical ductus. (Table II.)

COMPLICATED PATENT DUCTUS ARTERIOSUS

The problem of the complicated ductus with reversal of the shunt flow has received a great deal of attention. In this type of ductus, the patient has differential cyanosis. The head and arms, which receive only oxygenated blood from the left ventricle, are normally pink while the trunk and lower extremities, which receive mixed venous and arterial blood, are cyanotic. This reversal of the shunt flow may be a late stage in the evolution of the patent ductus. It usually occurs when the left ventricle begins to fail. It may be due to primary arteriosclerosis of the small vessels in the lungs. In either case,

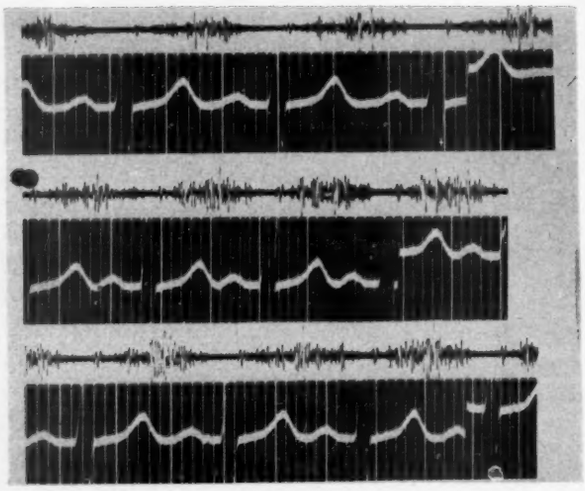


FIG. 3. Typical electrocardiogram and phonocardiogram of a patient with patent ductus arteriosus. Abnormally large QRS complexes are present. There is a continuous systolic and diastolic murmur.

there is right ventricular hypertrophy and pulmonary hypertension. This causes unoxygenated blood from the right ventricle to flow from the pulmonary artery back through the ductus into the aorta. Holman has suggested

TABLE II

OCCURRENCE OF VARIOUS SYMPTOMS IN THE HISTORIES AND FINDINGS ON PHYSICAL EXAMINATIONS

Clinical Findings	Per cent
Asymptomatic	41.3
Myocardial failure	42.0
Failure of normal growth and development	22.4
Subacute bacterial endocarditis	4.2
Frequent respiratory infections	31.5
Cyanosis (transient or differential)	10.5
Asthenia or malnutrition	22.4
Cardiac enlargement (physical examination)	53.8
Typical "machinery-murmur"	93.0
Thrill	80.7
Cardiac enlargement (x-ray)	56.6
Left ventricular hypertrophy (electrocardiogram)	14.0

that the ductus is a safety valve in these cases and that it would be dangerous to interrupt it.

In this series, there were two patients with such a complicated ductus. Both had severe pulmonary hypertension, reversal of the shunt flow and differential cyanosis. Both were female and both were in their twenties. Both patients underwent operation for interruption of the patent ductus. In one case, temporary

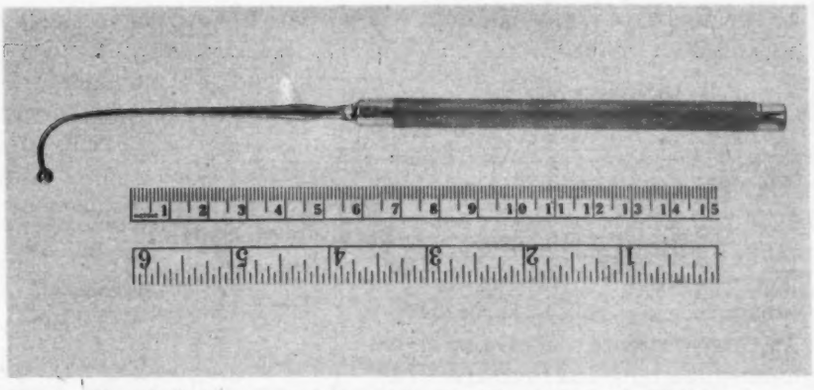


FIG. 4. The "ball-dissector" designed by Dr. Claude S. Beck. This instrument is valuable during dissection of the patent ductus arteriosus.

occlusion of the ductus caused immediate cardiac dilatation and arrest. The heartbeat was restored easily and nothing further was done. The patient recovered. In the second case, the patient was able to tolerate division of the ductus but died in acute heart failure six hours after the operation. This experience indicates that it is hazardous to interrupt a patent ductus when there is reversal of the shunt flow.

OPERATION

Surgical interruption of the patent ductus arteriosus is recommended when the diagnosis is made. If there is no urgency to perform the operation, it is preferable to wait until the infant or small child is four to six years old. The important details of the operation have been discussed by numerous authors. One point of technic will be noted. It is essential that the tissues behind the ductus be clearly visualized and divided by sharp dissection. To facilitate this dissection, Dr. Beck has designed a special instrument called a "ball-dissector." This instrument has not been described previously. It consists of a small steel sphere which is mounted on a conveniently curved handle. This ball is passed behind the ductus and sweeps the posterior tissues upward into a more accessible position for dissection. This instrument is also useful in operations for coarctation of the aorta, aortic aneurysm and arteriovenous fistula. (Fig. 4.)

The question of whether to divide or ligate the patent ductus has received considerable comment. Ligation carries the risk of possible erosion and hemorrhage from the ductus. In addition, in a small percentage of patients in whom the ductus is ligated, recanalization will develop, requiring a second operation. In the last eighty-eight consecutive patients (61.5 per cent) the ductus was sectioned and sutured. In the earlier cases, the operation consisted of ligating and suturing the ductus. In one of these patients recanalization developed. The ductus was sectioned and sutured during a second operation, five years after the original one.

In two patients, exploration alone was performed. One patient was a thirty-nine year old physician with an enormous patent ductus and dilatation of the aorta. At the time of operation (1941), it was believed to be inoperable. With more experience and the availability of better instruments, this ductus could probably be divided safely at the present time The second patient had a cardiac arrest during the mediastinal dissection. The heartbeat was restored and the operation was discontinued.

OPERATIVE MORTALITY

The mortality from operation has been low. Three of the 143 patients in whom operation was performed died in the immediate postoperative period. The crude mortality rate is 2.14 per cent. Two of these three deaths occurred in patients with a complicated patent ductus. In one patient there was severe pulmonary hypertension with reversal of the shunt flow. The other patient had subacute bacterial endocarditis at the time of operation. If these complicated cases are set aside, the corrected mortality rate for the simple patent ductus is 0.72 per cent. In the one uncomplicated case, death was due to the presence of a tenacious mucus plug which occluded both main stem bronchi. This caused anoxia and

cardiac arrest. The heartbeat was restored, but the patient died several hours later.

POSTOPERATIVE COMPLICATIONS

The average hospital stay was 10.4 days following the operation. The postoperative course was entirely uneventful in the majority of patients and the number of notable complications was low. There were no instances of postoperative hemorrhage, empyema or serious wound infection. In three patients pleural fluid collections developed which required thoracentesis. This has not occurred since a drainage tube has been used routinely. There was one case of severe postoperative atelectasis. In one patient postoperative laryngeal edema developed and tracheotomy was necessary. Four patients had prolonged periods of hoarseness following operation. In one case, there was drainage of lymph from the chest. When this occurs it is often due to accidental division of an intercostal lymphatic vessel. Treatment consists of prompt reoperation and exploration of the mediastinum. The divided lymphatic vessel should be accurately ligated. This was done in the case mentioned with excellent results.

A number of patients continue to have a soft to moderately loud systolic murmur after operation. Since this may occur even after the ductus has been completely divided, it is evidently not due to recanalization. There may be a small projection of the aortic wall at the point of origin of the ductus. This region easily could be the site of eddy currents which could cause a murmur.

FOLLOW-UP

The experiences in this report cover a period of fifteen years. All patients have been followed up for at least nine months. Follow-up questionnaires have been sent to all patients, but only fifty-two replies have been received. There have been no late postoperative deaths. In every case in which symptoms were present before operation, the patient reported complete or almost complete relief of symptoms. Five patients reported the continued presence of a systolic murmur. The average blood pressure following operation was 118/82 mm. Hg. The average pulse pressure was 36. Fifteen patients who had enlarged hearts before operation reported that the heart size decreased to normal. Two patients still have slight cardiac enlargement. In seventeen children with previous poor growth and development, excellent weight gains have been reported since operation. The following is a typical reply to the question of the patient's general condition: . . . "patient looks and feels like a different boy. Has absolutely no complaints."

SUMMARY

Between 1940 and 1955 a group of 143 patients with patent ductus arteriosus were treated surgically on the cardiovascular surgical service of Dr. Claude S. Beck. The histories of these patients have been analyzed. Data concerning age, sex, race, occurrence of various symptoms, physical findings and laboratory studies of these patients are presented. The use of a new instrument, the "ball-dissector," is described. Operative mortality is presented and postoperative complications are discussed. Follow-up reports are described.

Acknowledgment: Grateful acknowledgment is made to Dr. Claude S. Beck for his permission to use his records for this study, and for his helpful and stimulating criticism during the preparation of this report.

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Gangrene from Arterial Injuries Associated with Fractures and Dislocations of the Leg in the Young and in Adults with Normal Circulation

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UNNECESSARILY serious end results are being encountered too often with the rising accident rate and inadequate or ill-advised emergency treatment. In fractures of the leg and dislocations of the knee, vascular status is impaired. Existing ischemia is aggravated by thermal modalities, such as the frequent excessive use of heat and cold by the application of water bags and heat cradles or by inappropriate icing of an extremity. Acute ischemia may be, and not infrequently is, the forerunner of gangrene. Failures in treatment may be due to unfortunate timing of surgery or to iatrotechnics that do not carefully guard against accidental severing of blood vessels while dissecting the fascial plane, in exposing the neurovascular bundle and in handling of vessels.

The application of a tight cast or of a too firmly fitting cast or bandage, even an elastic bandage, may further injure the soft tissues and blood vessels. The unnecessary use of a tourniquet may worsen the circulation until local necrosis or gangrene is inevitable. Amputation becomes mandatory when response fails to conservative attempts at restoring circulation. In these attempts chemical interruption of chain ganglia is often importantly helpful. If the novocain® nerve block fails on second or third repetition, a careful surgical approach is necessary with popliteal, anterior or posterior tibial blood vessel exposure, or both vessels, and stripping of the adventitia. More recently, impaired vessels have been replaced by venous grafts (Case VI).

Evaluation of the patient's condition requires painstaking recordings of (1) how the injury was incurred; (2) the color of the leg; (3) local temperature changes; (4) oscillometric readings and observation of pulsations; (5) the patient's account of symptoms; (6) the patient's history, particularly so as to ascertain whether vascular impairment had ever been experienced in the form of intermittent claudication or night pains; and (7) vascular stigmas as evidenced by eye ground findings and cardiorenal-vascular disease.

Early decisions must be reached in resolving the problems of acute continuous pressure against a vessel by a large fragment of bone and vascular spasm from soft tissue hemorrhages with traumatic edema and tight fasciae.

Eight illustrative cases of major vascular disturbances associated with fractures and dislocations are presented. All came to my attention late in the course of treatment. Only two were private cases. The age range in this series is from nine to forty-eight in patients with histories of normal circulation [*1,27*] up to the time when the injuries were incurred. Amputations were necessitated in all but one case in which, although it was possible to save the leg, there is now residual (general) ischemia and amputation is still advisable.

CASE REPORTS

CASE I. (Fig. 1). R. G., a fifteen year old Negro boy, was admitted to the Cook County Hospital on August 10, 1951, with a history of having had his right foot caught in an elevator six days previously. An informant stated

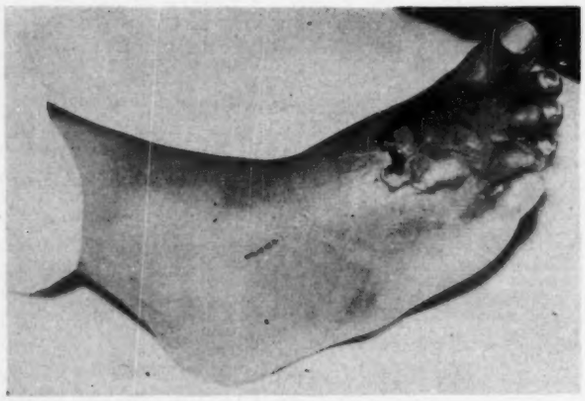

FIG. 1. Case I. Traumatic gangrene of foot. Note swelling, bleb formation and early dry gangrene.

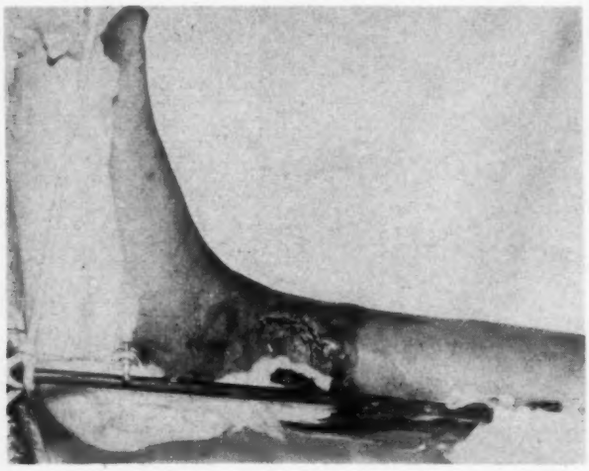

FIG. 2. Case II. Postoperative appearance of compound fracture of lower extremity. Severe edema of tissue. Early ecchymotic changes and livid skin over dorsum of foot, leg and inner aspect of leg. Skeletal fraction continued after open reduction.

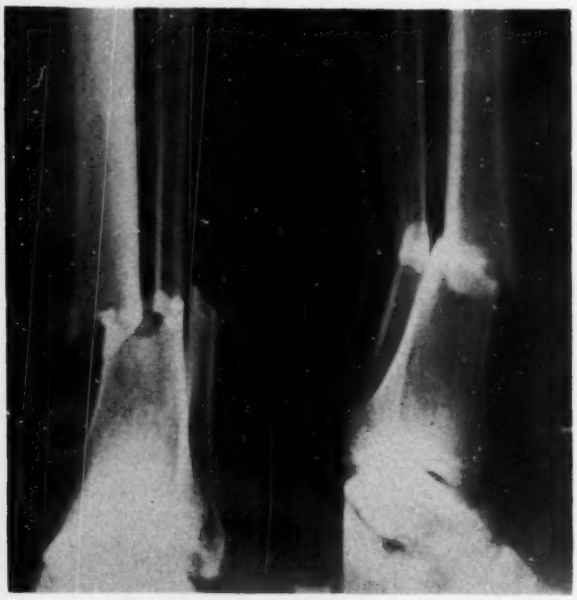

FIG. 3. Case II. Roentgenographic appearance of fractures of both bones of lower third of leg, transverse type, with displacement laterally and angulation posteriorly.

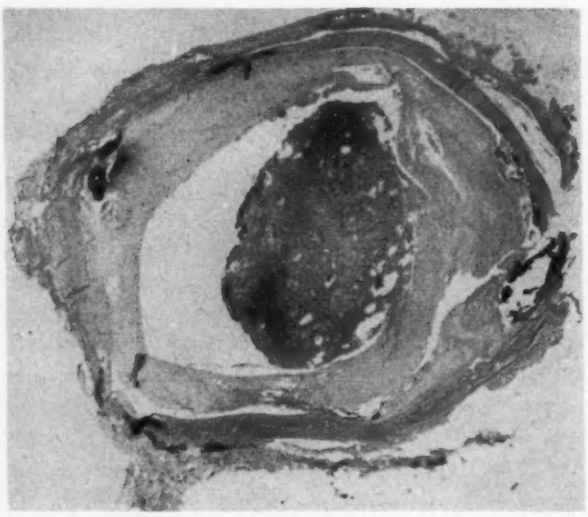

FIG. 4. Case II. Cross section of posterior tibial artery after open reduction and exposure of posterior tibial artery; intimal involvement and thrombosed area.

that the foot had been smashed and had been black but there had been no open wound. A cast had been applied and the patient discharged from the hospital where emergency treatment had been given, with the advice to return in six days. During the interval the toes became blanched and cold, and could not be moved. Pain was intractable. On the date of admission to Cook County Hospital the cast was removed, with the following observations:

The skin of all toes was discolored, dark blue to black. The dorsal pedal pulse was present. Several bullae were present over the dorsum of the right foot with excoriation between the third, fourth and fifth toes on the medial aspect. The color of the foot on the volar aspect was better. The patient was able to move the toes on the right foot but experienced pain in all toes over the distal areas corresponding to the metatarsals. Roentgenograms revealed fractures of the proximal phalanges of the first and fourth toes.

Penicillin and gas gangrene antitoxin were administered. The leg was elevated in a floating Thomas splint; daily scrubbing was done and sterile dressings were applied. On September 6th, because of the continued gangrenous

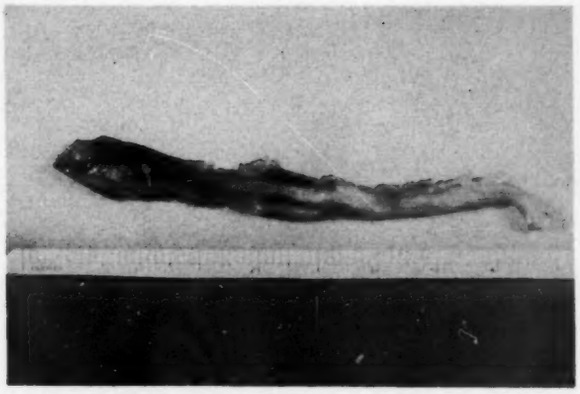

FIG. 5. Case II. Section of posterior tibial artery revealing arterial thrombosis at site of compound fracture (approximately 2½ inches in length).

condition, a mid-metatarsal amputation was performed under general anesthesia. The patient was discharged on October 2nd.

CASE II. (Figs. 2 to 5). T. J., a forty-six year old Negro man, was admitted to the Cook County Hospital on February 7, 1951, with a history of having been struck by a "flying board" in an industrial accident on the same day. A compound fracture of both the tibia and fibula of the right leg had been sustained near the ankle. Two hours after admission the patient was taken to the operating room where the wound was irrigated and debrided and the fragments aligned. Os calcis traction was exerted (7 pounds) with a Steinmann pin, inserted on February 11th. The same day the foot became cold with serosanguineous fluid draining from the site of the wound.

Treatment consisted of antibiotics (penicillin and streptomycin), papaverine, intravenous administration of sulfadiazine and daily sympathetic blocks. A large hematoma ensued at the wound site, with separation of sutures. The wound was opened and found to be infected. The patient's temperature rose to 102°F.; the pulse was 104. The toes were immobile and remained cold and cyanotic. The wound continued to drain a bloody serous material, and gangrene advanced to the leg. The patient's leg was elevated at heart level; antibiotics were continued, and on February 15th, etamon® chloride (tetra-ethyl ammonium chloride), 5 cc. daily, was injected into each hip; nevertheless, pulsations were not felt in the posterior tibial artery. On February 18th, on consultation, a diagnosis was made of

FIG. 6. Case III. Early gangrene of first, second and third toes; tissue necrosis of dorsum of foot and medial aspect of foot and ankle, consequent to compound fracture of left leg. Note discoloration.

FIG. 7. Case III. Roentgenogram of comminuted compound fractures of both bones of leg.

traumatic arteritis with thrombosis, requiring amputation. Five days later amputation was performed under general anesthesia. A thrombus was found in the posterior tibial artery. The patient was discharged on March 15th after an uneventful recovery.

CASE III. (Figs. 6 and 7). W. B., a thirty-eight year old Negro man, had been struck by an automobile and sustained a comminuted compound fracture of the lower third of the left tibia and fibula. He was given first aid and sent to Cook County Hospital where he was admitted on February 10, 1952. Both

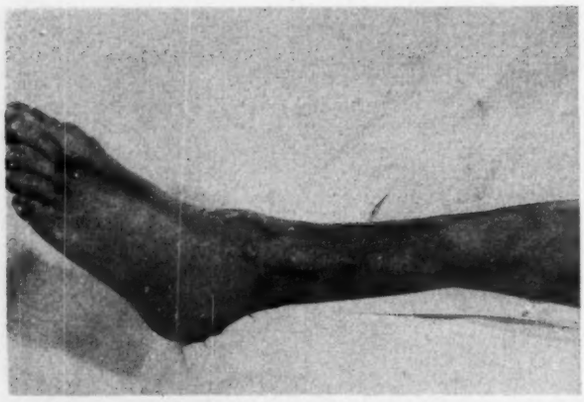

FIG. 8. Case IV. Early gangrene of extremity. Note livid areas and patchy necrosis of tissue over dorsum of foot.

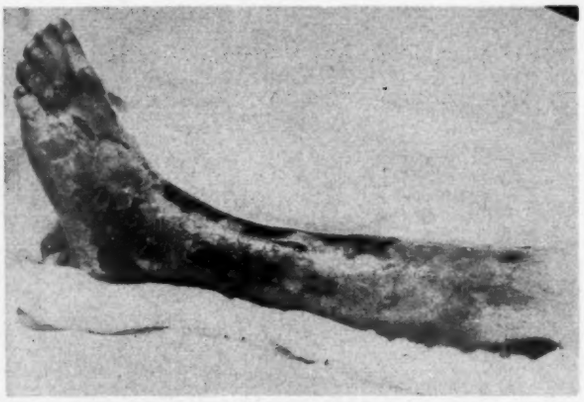

FIG. 9. Case IV. Photograph of same leg ten days later. Note desquamation of skin, tissue necrosis and gangrene, and changes in color of skin.

bones of the left leg had been fractured. Two inches of the tibia extruded through the skin of the lower leg. There was also a dislocation of the left shoulder joint. The patient was taken to the operating room on the day of admission, the wound was débrided and irrigated with Dakin's and saline solutions, and the bone fragments were approximated after a careful cleansing of the skin. The subcutaneous tissues were closed with No. 00 chromic catgut and the skin was sutured with interrupted silk sutures. A long leg cast was applied. Antibiotics (streptomycin and penicillin) were given, as well as tetanus antitoxin and 500 cc. of blood. The dislocation of the left shoulder was reduced the next day under general anesthesia, and the following day a Steinmann pin was inserted in the os calcis.

On February 13th, the foot was cold, cyanotic and pulseless. On February 28th, gangrene of the first two toes with advancement toward the leg was observed. There was local infection of the compound fractured site. Pain continued, and despite a sympathetic block and continued antibiotics, amputation below the knee was suggested and performed on April 15th. The patient thereafter made an uneventful recovery and was discharged on May 2, 1952.

CASE IV. (Figs. 8 to 10). A. G., a forty-five year old white man, was admitted to the Cook County Hospital on February 28, 1950, because of injury to the left ankle incurred six hours before admission when he tripped over broken pavement which caused a bimalleolar fracture with displacement. There was a history of chronic alcoholism. Crepitation was heard on palpation. The dorsal pedal pulsations and posterior tibial pulsations were good. There was no evidence of vascular or nerve impairment of the left ankle. Roentgenograms revealed the fracture dislocation of the distal third of the left fibula.

Under anesthesia the fractured segments were manipulated on the day of admission. Postreduction roentgenograms revealed good reduction. The patient had had mild delirium tremens since admission.

Penicillin and tetanus antitoxin were given. Two sympathetic blocks were done, heparin was tried, and the foot was elevated at heart level. Notwithstanding these efforts, the temperature rose daily to 100°F. The toes remained cool and numb. Sensation was reduced throughout the foot and leg. The cast was removed. A 1 per cent procaine block gave some response. The toes blanched on pressure, with fairly rapid return of superficial collateral circulation.

On April 7th, a guillotine type amputation, 3 inches below the knee, had to be performed. The patient required 500 cc. of blood during surgery. He made an uneventful recovery and was discharged on May 15, 1950.

CASE V. J. C., a nine year old Negro boy, was admitted to Cook County Hospital on April 28, 1955. The roof of a garage had caved in, injuring his right foot, with severe compounding of the metatarsal and phalangeal bones and protrusion of the metatarsals on the dorsum of the foot. The right foot was

10A 10B

FIG. 10. Case IV. A, postoperative appearance of amputation site. B, original fracture dislocation of ankle.

lacerated with trauma to the tendons and soft tissues and extensive soft tissue loss. The toes were cold.

On the day of admission, débridement was done, cut vessels were tied, and the wounds were closed with vertical mattress wire. Whole blood, 500 cc., was given as were antibiotics and tetanus antitoxin. A lumbar block was done with some increase of the circulation as evidenced by warming of the foot. Procaine blocks were continued and tetanus antitoxin was repeated (7,500 units). A long leg cast had been applied but was cut and spread the same day. The patient reported pain in the right foot. Heparin and left lumbar sympathetic blocks did not improve the color eight hours later. The popliteal pulse could not be felt. A superficial slough appeared, apparently not gangrene, and the patient's temperature rose to 100°F. Sensation was absent from the toes to the knee. Viability seemed somewhat improved under conservative management but as the thigh became edematous and the temperature rose to 102°F., an area of gangrene appeared on the dorsum of the right foot. Roentgenograms disclosed gas in the tissues. With the foot draining and the distal portion of the foot dry, cold and black, metatarsal amputation had to be performed on April 29th. On May 19th a secondary closure of the stump was done and a posterior molded cast was applied with dressings, because of purulent drainage. The patient made an uneventful recovery after amputation of the entire right foot.

CASE VI. (Fig. 11). L. W., a twenty-three year old man, had incurred a compression injury when caught between two automobile bumpers. He had had a compound dislocation

FIG. 11. Case VI. Left, dislocated knee joint after correction and immobilization in a cast. Right, post-operative appearance of knee joint after an attempt to fuse joint. No evidence of bone repair.

FIG. 12. Case VIII. Note discoloration of toes, foot and leg. Livid discoloration extends to knee joint. Note severe edema.

of the left knee joint with two deep wounds over the knee anteriorly. Emergency treatment had been given at Holy Cross Hospital on February 9, 1952. A cast had been applied loosely and the wounds sutured. At that time the anterior tibial pulse was reported as plus 1, the posterior tibial pulse as 0. The patient had received 30 cc. of 1 per cent procaine as a paravertebral injection, and 100 mm. of procaine intraspinally to vasodilate the extremity. This was followed by alcohol by mouth and 2 cc. of etamon three times a day. Conservative management, however, was unsuccessful.

Under general anesthesia, sympathectomy was performed. The popliteal area also was explored; a 5 cm. area of the artery had thrombosed. This area was excised and a popliteal graft was inserted by Dr. John Reynolds. The saphenous vein of the same leg was used to traverse the popliteal artery. The patient was treated for severe shock. Apparent improvement of the local circulation ensued. Skeletal traction was exerted through the calcaneus, and the extremity was elevated in a Thomas splint. Pulsations ultimately returned, with oscillometric readings of 1 to 1½ units.

Subluxation of the knee joint persisted with associated pain, thus the need for a long hip brace with leather thigh and leg cuffs.

On February 12, 1953, operation was performed. A tourniquet was not used. The midline incision was made, and the patella removed and later used as a graft between the femur and the tibia. After careful removal of bone of both ends, the patella was denuded of its periosteum and cartilage was inserted. Two Steinmann pins were used to fix the bone. Temperature readings by the UVA thermometer were made. The left foot, before surgery, had been warm to hot; the right one, cold and clammy. The patient's general condition was satisfactory. Ten hours after surgery the left foot was cool, the right one, warm. The toes could be moved a little but the patient felt only pressure.

Follow-up on November 22, 1955, found the patient satisfied with the result, although a brace had not helped subluxation of the foot; however, improvement did not last. On later follow-up, edema had greatly increased.

Knee joint fusion was performed at Mt. Sinai Hospital, Chicago. The patient was placed in a spica cast, with two pins staggered for better contact and proper positioning. Dr. David Lerner was consulted on the tenth post-operative day because of diarrhea, toxicity and fever associated with infection of the wound. On May 18, 1954, an amputation, 22 cm. above the knee joint, was performed by Dr. Felix Winskunas.

When the amputated extremity was examined, inflammatory and indurative material was found in and about the knee joint; a number of enlarged lymph nodes were also seen in

FIG. 13. Case VIII. Upper third of tibia and fibnla with comminuted fractures of both bones.

FIG. 14. Case VIII. Results of arteriogram indicating a complete block at junction of anterior and posterior tibial artery. Some collateral circulation of the lateral genicular arteries.

the popliteal fossa. The grafted section of artery was difficult to distinguish from the natural artery. The site of anastomosis was difficult to detect distally; the proximal side was somewhat easier to determine. The replacement made by Dr. John Reynolds measured 8 cm. The patient since has been fitted with a prosthesis and is getting along well.

CASE VII. E. J., a twenty-three year old man, in January, 1952, reported a history of having had a complete dislocation of the knee five years previously, with "gangrene that came on with a torn nerve." Emergency treatment had been given under anesthesia at the Norwegian American Hospital two hours after injury. The dislocation had been reduced and a cast applied. Gangrene and local necrosis ensued. A triple arthrodesis was done because of severe equinus in 1948; in 1950, a skin graft was required on the dorsum of the foot.

Physical examination revealed extreme genu recurvatum with continued equinus (40 degrees) of the ankle. Oscillometric readings were 1½ units. A foot brace was ordered in December, 1952, but the patient had difficulty in adjusting and using it. He found a bandage more satisfactory. Tissue irritations took place under the plantar surface of the foot and a callus formed under the metatarsal-phalangeal joint. Oscillometric readings of the right calf were plus 4; on the left, plus 2 units to 110 mm. of hemoglobin. Pulses could not be felt.

A diagnosis was made of ischemia of the muscles with tissue necrosis following vascular and nerve injury.

On follow-up, the foot was pulseless. All symptoms were worsening. Amputation was advised but refused.

CASE VIII. (Figs. 12 to 14). M. H., a forty-eight year old woman, had had both bones of the left leg fractured on January 31, 1952. On admission she had pain; paresthesia, numbness and gangrene of the left toes were noted. Anterior and posterior tibial artery pulses were

TABLE I

EIGHT CASES OF GANGRENE IN THE YOUNG AND IN ADULTS WITH NORMAL CIRCULATION

Case No.	Patient	Sex and Age (yr.)	Diagnosis	Surgical Treatment	Pathology	End Results
I	R. G.	M, 15	Traumatic compression of right foot; compound fractures of foot	Mid-metatarsal amputation	Severe tissue edema with traumatic arterial thrombosis (digital arteries)	Satisfactory
II	T. J.	M, 46	Compound fractures of both bones of right leg	Débridement at first; later, amputation below knee	Thrombosis (posterior tibial artery)	Satisfactory
III	W. B.	M, 38	Compound fracture of left leg	Cast and pin; later, amputation below knee	Thrombosis (posterior tibial artery (iatrotechnic)	Satisfactory
IV	A. G.	M, 45	Bimalleolar fracture of ankle	Cast used primarily; guillotine amputation below knee	Local thrombosis; phlebitis, anterior and posterior tibial arteries (iatrotechnic)	Satisfactory
V	J. C.	M, 9	Compound fracture of foot; tarsal and metatarsal fractures	Mid-metatarsal amputation	Thrombosis, digital vessels	Satisfactory
VI	L. W.	M, 23	Compound fracture of left knee with dislocation	Reduction and cast; popliteal artery graft (8 cm.); knee joint fusion; ultimate amputation	Thrombosed artery; toxic absorption; infected wound; enlarged lymph nodes	Satisfactory with prosthesis
VII	E. J.	M, 23	Dislocation of knee; equinus foot deformity	Reduction and cast; skin graft on foot	Local gangrene; local tissue necrosis	Patient satisfied with result; knee still subluxated; brace of no help
VIII	M. H.	F, 48	Both leg bones fractured	Early cast; surgical blocks (three); amputation	Large necrotic area, foot; left toes gangrenous; postoperative infection, stump; degenerated muscles	Stump later satisfactory; unrelated subsequent fractures

absent. A cast had been applied early and three sympathetic blocks had been unsuccessful. On February 11th, the cast was reapplied. By March 9th, the toes were completely gangrenous. On March 25th, an arteriogram was made and a block done at the junction of the anterior and posterior vessels. Daily dressings were applied to the leg. A large necrotic area appeared at the knee. Amputation was refused.

Antibiotics and dressings were continued until discharge. On June 15th the patient was readmitted and on the 20th amputation was performed below the knee. Postoperative infection was a complication. The pathologist reported degenerated muscles. The patient is a chronic alcoholic and required four readmissions for fractures at other sites incurred when falling; however, the stump was satisfactory on each succeeding examination.

COMMENTS

In each case reported, gangrene occurred in a young person or one in the prime of life who before injury had had normal circulation with-

out any history of vascular disturbance. Gangrene was a consequence even when every possible opportunity was given the patient to regain circulation: rest, relief of pressure, heart-level elevation of the leg, repeated and careful sympathetic blocks, vasodilators, and even venous grafts.

Repeated examinations with careful recording may be necessary for re-evaluation of symptoms from time to time, as in Case VI. Surgical technics must never be careless of anatomic considerations. The tourniquet should not be used unless it is absolutely necessary.

The presence of gangrene calls for early decision regarding amputation. Local thrombosis with gangrene associated with phlebitis or infection requires guillotine amputation (Case IV) with secondary closure or reamputation (Case V).

Chronic ischemia associated with dislocation of the knee may mean that the patient would fare better with earlier amputation, as in Case VI, in which, notwithstanding early sympathetic blocks, vasodilators and evidence of good collateral circulation as well as circulatory assistance by saphenous vein replacement for the popliteal artery, knee joint fusion failed, although surgical healing resulted. Eventual amputation had to be resorted to because of pain, paresthesia, deformity of the foot and the necessity of a long leg brace.

In the second case of this nature (Case VII), there is also every evidence of poor circulation; the foot is pulseless and has poor color. Ulcers are frequent; there is tissue necrosis. Changes are more pronounced in cold, wet weather. The patient continues to have fatigue and weakness, and foot deformity (fixed 40 degree equinus position) is severe and associated with callosities and abnormal pressure areas. Pain and paresthesia will continue in this deficient vascular limb. Amputation has been advised while the patient's general condition is still satisfactory.

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Fractures of the Femur in Children

AN ANALYSIS OF THEIR EFFECT ON THE SUBSEQUENT LENGTH OF BOTH BONES OF THE LOWER LIMB

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ALTHOUGH many writers, notably Blount [5], have said in recent years that lengthening of the leg may follow fracture of a child's femur, this sequel does not seem to be as widely known as it should be to surgeons outside the specialty of orthopedics. As Blount has written, "Treatment of fractures of the femur in children in the past has been lacking in appreciation of the late sequelae. Each patient must be followed until one can be sure that there will be no inequality of leg length. The surgeon who treats such deformities must keep as his goal the ideal appearance and function of the extremities when the children are through growing."

The first modern report of lengthening of the leg after fracture was by Truesdell in 1921. Since then many reports have appeared; of particular interst are those of Burdick and Siris, Cole, Conwell, McMechan, Bisgard and Mortenson [3,4], Aitken et al. [1,2], Blount et al. [6], Hedberg and Pease. From the work of these men the following conclusions seem to have been established: Lengthening of the lower limb usually follows fracture of the femur in a child; the lengthening usually is of the order of 1 cm.; the lengthening is not affected by the position or type of fracture; it is greatest according as the amount of callus formed is greatest, and in children between four and eight years of age; and the lengthening occurs in the first year after the fracture and is thereafter fixed. It has also been stated that sometimes the tibia of the injured leg, as well as the femur, increases its growth. This increase of growth appears to be caused by stimulation of the epiphyses distal to the fracture.

In all these reports none of the measurements of the limbs was made with an accurate technic; tape measures were the means most frequently used. The differences in length were not related to the difference of length between members of a pair of normal legs. Only the total increase was noted; the relative parts played by the femur and the tibia were not estimated.

This article has been written to affirm and to re-emphasize the fact that the length of a child's leg may increase or decrease relative to its fellow after fracture of the femur of that leg. An attempt is made to elucidate the factors influencing the change of length and to estimate the roles of the femur and tibia. Although the number of cases is few, we believe that careful analysis, with the use of more accurate methods than have been used before, will be helpful in solving this problem.

METHOD

The sex of the children, age at the time of fracture, type and position of the fracture, and the method, effectiveness and duration of treatment were noted from the records. All children were called in for a personal follow-up examination; the functional result was assessed and the legs were measured by tape measure. Roentgenograms of the legs were then made using the following technic: The patients' legs were laid on a radiolucent rule with radiopaque centimeter and millimeter markings, and cone views of both hips, knees and ankles were taken on the same plate from a height of 48 inches, centered directly over the central line at the level of the joints. Thus each roentgenogram

contains three pictures: one of each pair of joints, and alongside each joint appears a section of the rule. (Fig. 1.) The difference between the reading corresponding to the upper end of one bone and that corresponding to the lower end of the bone will be the length of the bone. In seven children ordinary lateral and anteroposterior views of the affected femurs were taken at the same time.

The initial roentgenograms of the fracture (Figs. 2 and 3), those made at the time of dismissal of the patient (Figs. 4 and 5), and those made at the follow-up examination (Figs. 6 and 7) were reviewed. Since we did not know accurately the length of the leg either before or immediately after the fracture, or at the time of dismissal of the patients, the amount of shortening caused by the fracture was estimated relative to the diameter of the bone at the mid-point of the site of fracture. If the shortening was less than half this diameter, it was graded as "slight"; if it was more than half but less than the whole diameter, it was graded as "moderate"; if it was more than this, it was graded as "severe." Shift was estimated in the same way. In addition, the direction of the shift and the direction and degree of angulation were noted.

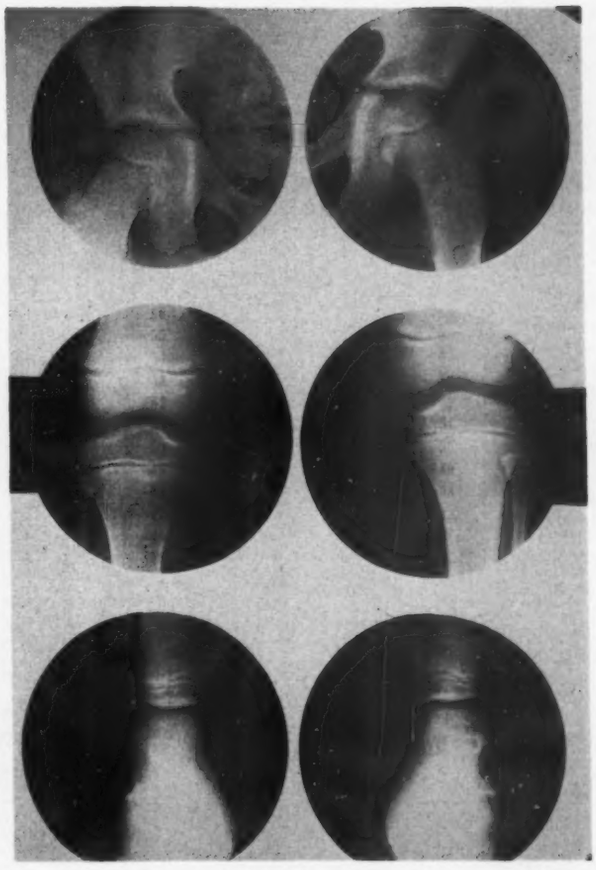

FIG. 1. Scanograms made three and a quarter years after injury. There is 0.9 cm. shortening of the left femur; lengthening of the left tibia amounts to 0.2 cm.

NORMAL DIFFERENCES IN THE TWO LIMBS

It is obviously very important to know what difference in length there may be between the two lower limbs of normal people. In 1937 Dorrance, using a tape measure, found that of 2,000 normal men 10 per cent had an inequality of ½ inch in the lengths of their legs. However, in 1952 Trotter and Gleser, measuring anthropometrically the bones of 2,000 adult skeletons (half were skeletons of war dead brought back to this country from overseas and half were skeletons in the Terry collection at St. Louis), concluded that of a normal pair of femurs the left femur would be .111 cm., ±.018 cm., longer than the right, and of a normal pair of tibias the left would be .028 cm., ±.014 cm., longer than the right.

SERIES

Fourteen children less than ten years of age, whose fractures of the femoral shaft had been treated at the Mayo Clinic between 1944 and 1952, were examined. This group was selected simply on a geographic basis, in that they lived near enough to the Clinic to be able to report for re-examination. The injuries in this group were representative of all fractures of the femoral shaft among children seen at this Clinic in the same period in respect to the factors of age, sex, side, site, type, treatment and functional result. The children were seen at an average time of five years, eight months after they had sustained a fracture, the shortest time being two years, three months and the longest being nine years, three months. Their ages at the time of the fracture varied from six weeks to nine years. Seven were between four and eight years old; seven were older than the mean age, and seven were younger than the mean age. Only one child was more than eight years of age, whereas two were less than one year of age. Twelve were boys and two were girls. Seven had sustained fractures on the left side and seven on the right side. Five fractures were spiral, five were oblique and four were transverse.

There were no pathologic fractures in the

2 3

FIG. 2. Original anteroposterior picture. Slight shortening treated by six weeks in a long, single spica cast.

FIG. 3. Original lateral roentgenogram; 5 degrees of anterior angulation.

series. Four fractures had occurred at the junction of the middle and upper thirds, eight were in the middle third and two were in the lower third of the shaft. One fracture was compound and one was slightly comminuted. Nine of the fractures had been treated initially by traction for an average of three weeks (maximum five weeks and minimum two days), followed by application of a hip spica cast for from three to six weeks; one of these was treated in a double spica cast and the others in a single spica cast. One was treated in a single spica cast from the beginning for six weeks, one was treated by Bryant's traction alone for four weeks and three were treated by open reduction and immobilization in a spica cast.

One of these patients initially had been treated elsewhere by application of a plate; the plate had been removed after ten weeks and the extremity maintained in a cast for six weeks, at the end of which time there was no sign of union. The fracture was then remanipulated here and a double spica cast was applied for an additional eight weeks; at the end of this time the fracture had healed. Although this patient was not treated here at the start, the data are included because they are instructive. For the other two patients who were treated by open reduction, internal fixation was not used; one patient had sustained a compound fracture at the junction of the middle and upper thirds of the femur, and one had sustained a fracture of the lower third. Both were in traction for one week before operation, and open reduction was resorted to because of the failure of traction to reduce gross displacement. The ages of these three children were six, eight and five years, respectively.

RESULTS

Femoral Length

Increase. Ten of the fourteen children were found to have increased length of the fractured

4 5

FIG. 4. Anteroposterior roentgenogram made five and a half weeks after injury.

FIG. 5. Lateral roentgenogram made five and a half weeks after injury. Severe shortening is seen. There is anterior angulation of 15 degrees.

femur at the time of follow-up examination. The average increase was 0.6 cm. In five cases it was less than this; in two cases it was exactly this; and in three cases it was more than this. The smallest increase in length was 0.1 cm. and the greatest increase was 1.4 cm.

This group has been subdivided into three: those in whom the increase was less than 0.5 cm. (four children); those in whom the increase was between 0.5 and 1 cm. (four children); and those in whom the increase was more than 1 cm. (two children). The fractures of the two children with the greatest increase in length of the femur had been reduced by operation without internal fixation. The increases were 1.2 and 1.4 cm. One of these children had sustained a compound fracture, the only one in this series.

In the group with an increase of between 0.5 and 1 cm., only one child was less than four years of age and none was more than eight years of age. All fractures in this group were sustained in the middle third or at the junction of the middle and upper thirds of the femur. Three of these fractures were severe in respect to displacement, shortening or angulation, alone or in combination, and they were all markedly improved by manipulation or traction. The fourth fracture was the only spiral fracture in this group, and was sustained by a two year old boy; there was only slight short-

6 7

FIG. 6. Anteroposterior roentgenogram made three and a quarter years after injury.

FIG. 7. Lateral roentgenogram made three and a quarter years after injury. There is residual angulation of 15 degrees.

ening initially and this shortening was reduced completely by traction.

The four children who had the smallest increase in length of the femur were younger as a group than the others, three being less than four years of age. Their fractures were similar in type and site to those of the children in the second group. However, with one exception the displacement, angulation and shortening were not severe at first and were altered only slightly by treatment. The one exception was a three month old baby who sustained a transverse fracture of the middle third of the femur, the angulation of which was reduced by traction from 40 to 10 degrees. However, in this case both shift and shortening were slight at first although there was moderate shift when the fracture was healed.

Decrease. The injured femurs of four children were shortened. The decreases were 0.3, 0.4, 0.9 and 1 cm. In three of these cases the fractures were spiral; initial position of deformity and shortening either increased or did not alter with treatment. The children affected were two, three and nine years old. These were the three patients with the greatest degree of shortening. In the two who had shortening of 0.9 and 1 cm., the shortening immediately on healing was graded as severe on the basis of roentgenograms, whereas in the third, with shortening of 0.4 cm., it was graded as moderate. The fourth child, six years of age, was treated by operative reduction and internal fixation; the plate was removed, but six months later, despite continued immobilization, the fracture had not healed and did not

do so until remanipulation. The extremity was then placed in a double spica cast for eight weeks. There was no apparent shortening in the roentgenograms made immediately after healing.

Comment on Femoral Length. On the basis of results obtained among these ten children, it would seem that operative reduction of the fracture caused the greatest increase in length provided satisfactory and prompt healing occurred but even though internal fixation was not used.

The most severe increases in femoral length after conservative treatment occurred among those children between four and eight years of age whose fractures were severely displaced and were well reduced. In such cases the increase may be expected to be between 0.5 and 1 cm. in the femur. The smallest increase in length—less than 0.5 cm.—appears to occur among children outside the age range of four to eight years whose fractures are not severely displaced and in whom the treatment has only a moderate effect.

Decreased length of the femur may be expected in children who sustain spiral fractures; in this series the children who had had such a fracture were outside the ages of four and eight years. Presumably there is considerable difficulty in restoring the fractured bone to its normal length by closed methods in this type of fracture. Instability is characteristic, and the shortening forces act constantly during healing.

Long-continued immobilization will cause decreased length of the bone in these injuries, as in other diseases. This type of decrease presumably is due to lack of epiphyseal stimulation, whereas among those children who have normally healing spiral fractures the shortening takes place at the site of fracture.

Tibial Length

Increase. The length of the tibia on the same side as the fractured femur was increased in nine children. The increase varied from 0.1 to 0.6 cm.; the average was 0.3 cm. Five of the children had an increase of less than 0.3 cm.; one had an increase of 0.3 cm.; and three had an increase of more than 0.3 cm. The injured femurs of six of these children were increased in length, and the remaining three children had sustained spiral fractures and shortening of the femur.

Decrease. In four children the length of the tibia on the same side as the fractured femur was less than that of the opposite tibia. The decreases were 0.3, 0.3, 0.5 and 0.9 cm. The two who had a decrease of 0.3 cm. were the two youngest children in the series; their ages were six weeks and three months at the time of injury. The child with the decrease of 0.5 cm. had sustained a fracture of the opposite tibia in the same accident in which the femur was fractured. The child with the decrease of 0.9 cm. was the one who had delayed union and eight months' immobilization.

Equal. The tibias of one child were equal in length. This child was the one with a transverse fracture of the lower third of the right femur; the fracture was reduced by surgery. The increase in his femur was 1.4 cm.

Comment on Tibial Length. These cases indicate that when a child sustains an uncomplicated fracture of the femur the tibia increases in length as often as the femur does. The length gained is, on an average, half that gained by the femur. The increase in the length of the tibia does not vary as much as does the increase in the length of the femur. However, increased length of the femur is not necessary for tibial increase to occur; there were in fact three patients who had shortening of the femur and lengthening of the tibia, compared with the corresponding bones on the other side. Moreover, the increase in the length of the tibia does not seem to be changed very much by the severity of the femoral fracture or the accuracy of the reduction.

The tibias of the injured legs of four patients were shorter than the tibias on the other side. In one the opposite tibia was fractured and it overgrew; in another the leg was immobilized for so long that growth of bone was slowed; the remaining two were the only children in the series younger than one year old, but in no other way were they remarkable. It would appear that at this age stimulation of growth of the tibia does not occur after fractures of the femur, as it does in children of an older age. The mechanism of this effect is unknown.

Total Length of Leg

This is the sum of the differences in length between the femur and tibia of the injured side and their fellows. It is the factor of most concern to the patient.

Increase. Eight children had a total increase on the fractured side. (Table I.) The average increase was 0.9 cm.; there were three patients with less than this, and five with more. The average lengthening of the femur was 0.7 cm., a little higher than the average for all the lengthened femurs. The average lengthening of the tibia was 0.2 cm., a little less than the average lengthening for all the tibias. However, if the two cases of depressed tibial growth are omitted, the average lengthening is 0.3 cm., the same as for all the tibias.

There were no cases of shortened femurs.

Decrease. Six children had short legs on the fractured side. (Table II.) Three of these had short femurs with lengthened tibias; two had lengthened femurs with a greater shortening of the tibias, and one had both a short femur and a short tibia. The three with short femurs and lengthened tibias were the three with spiral fractures which ended with shortening of the femur. The femoral decreases were 0.4, 0.9 and 1.0 cm. The tibial increases in these three children were 0.3, 0.2 and 0.2 cm., respectively, so that the total decrease in each case was 0.1, 0.7 and 0.8 cm., respectively. (Table II.)

Of the two children with longer femurs and greater shortening of the tibias on the injured side, one was among the very young children with a spiral fracture and the other was a child whose opposite tibia had been fractured. These two had increases in the femurs of 0.1 and 0.2 cm., respectively, and decreases in the tibias of 0.3 and 0.5 cm., respectively, giving a total shortening of 0.2 and 0.3 cm., respectively. (Table II.)

The child with shortening of both the femur and the tibia was the child with delayed union. He had shortening of 0.3 cm. in the femur and of 0.9 cm. in the tibia, a total of 1.2 cm. shortening. (Table II.)

TABLE I
TOTAL INCREASE IN LENGTH OF LEGS IN EIGHT CHILDREN WITH FRACTURE OF THE FEMUR

Patient	Increase, in Centimeters		
	Total	Femur	Tibia
1	+1.1	+0.9	+0.2
2	+1.0	+0.6	+0.4
3	+0.7	+0.6	+0.1
4	+1.1	+0.5	+0.6
5	+0.6	+0.1	+0.5
6	+1.4	+1.2	+0.2
7	+1.4	+1.4	0
8	+0.1	+0.4	−0.3

TABLE II
SHORTENING OF LEGS IN SIX CHILDREN WITH FRACTURE OF THE FEMUR

Patient	Shortening, in Centimeters		
	Total	Femur	Tibia
1	−0.7	−0.9	+0.2
2	−0.3	+0.2	−0.5
3	−0.1	−0.4	+0.3
4	−0.2	+0.1	−0.3
5	−0.8	−1.0	+0.2
6	−1.2	−0.3	−0.9

Comment on Total Length of Leg. If there is a greater-than-average increase in the length of the femur, the leg will be longer than its fellow, whatever the tibial length. If there is a smaller-than-average increase in the length of the femur, the leg may be shorter or longer than its fellow, depending on the tibial length. If there is a shortened femur, the leg will be shorter but the amount of shortening will depend on the increase or decrease in the length of the tibia. When the two bones act in opposition, the alteration in length is likely to be below average.

Residual Angulation

In seven cases the degree and direction of the angulation at the site of the fracture were estimated at the follow-up examination and were compared with the degree and direction of the angulation immediately after healing of the fracture. Angulation had decreased in three patients from 15 degrees anterior to 10 degrees lateral, and from 30 to 20 degrees lateral, and from 10 degrees posterior to 0 degree; it had not changed in two, 0 and 15 degrees anterior, and had increased in two, 0 to 5 degrees anterior and 0 to 12 degrees anterior.

Comment on Residual Angulation. On the basis of the foregoing there seems little tend-

ency for the angulation to reduce spontaneously. The two children whose angulation was increased were immobilized for an adequate length of time, and radiologically their fractures were sound at the time of dismissal. It is worthy of note that all changes were in a lateral or anterior direction.

Only seven patients were included in this section because they were the only ones for whom full sets of roentgenograms were available.

The direction of angulation is taken as the direction in which the angle points, not that to which it is open.

In all these cases there was no complaint of loss of function. The angulation did not seem to affect function or the length of the femur.

Clinical Length

Both extremities of all patients in this series were measured by tape measure from the anterosuperior iliac spine to the medial malleolus, and scanographic measurement also was done. The results of each method were compared. They comprise three groups:

1. In six cases the correct side was named the longer by tape measure; in three of these the estimated increase in length was short by 0.2, 0.2 and 0.4 cm. as compared with scanographic increases of 1.1, 0.8 and 0.7 cm. In the other three the estimate was longer by 0.4, 0.4 and 0.6 cm. as compared with actual increases of 1.4, 1.4 and 0.8 cm.

2. In seven cases the legs were estimated to be equal when scanographically it was found that one was longer than the other. The errors were 0.1, 0.1, 0.1, 0.2, 0.3, 1.0 and 1.2 cm.

3. In one case the wrong leg was estimated to be longer than the other when scanographically the length of the other leg was found to be increased by 1.1 cm. The total error in this case was 2.3 cm.

There was considerable variation in the relative accuracy of the measurements. It is not possible, on the basis of such a small number of observations, to draw any valid statistical conclusions therefrom; however, it is striking that in no case did the two measurements, achieved by two different means, equal each other. Moreover, although the longer leg was correctly named so, in three cases in which the difference was less than 1 cm. and in two in which the difference was more than 1 cm., the lengths of the legs were called "equal." Again, in all cases in which the difference was less than 0.5 cm. the legs also were called "equal" in length.

Function

In all but three cases in the series there were no complaints. Two of the three patients concerned complained of slight aching; one said aching occurred in wet weather and the other mentioned aching around the knee. The third had limitation of knee motion, the range being 165-degree extension to 70-degree flexion only. This boy had sustained a compound fracture of the upper third of the femur that had been reduced by surgery.

CONCLUSIONS

In ten of fourteen children who had sustained fractures in the mid-part of the femur the length of the femur was increased by an average of 0.6 cm. The length tends to be increased most in: (1) children between four and eight years of age, (2) those who have sustained severely displaced fractures that are well reduced, and (3) those who have sustained fractures that are treated surgically.

Femoral length was decreased in four cases. In three of these four cases spiral fractures had occurred; the shortening occurred at the site of fracture. In the other case long-continued immobilization seemed to cause the shortening.

In nine of the same fourteen children the tibia was longer by an average of 0.3 cm. than its fellow. Shortening of the tibia seemed to be referable to infancy and to long-continued immobilization.

The increase or decrease of total length of the leg, compared with the length on the opposite side, follows the femoral changes. These are affected as outlined heretofore. However, if the femur is only slightly lengthened, the increase or decrease depends on the change in the tibia; in any case, it is slight. When the bones work in the same direction, the change is greatest; it is minimized when the bones work in opposition. It is rare for both tibia and femur to be shortened, but not uncommon for one to be lengthened and one shortened.

Residual angulation shows little tendency to correct itself, and it may increase anteriorly or laterally.

Clinically, differences of 0.5 cm. or less are not detected by the tape measure. Legs of

unequal length may appear to be equal when the tape measure is used, even if the inequality is 1 cm.

Function is good unless the injury was very severe.

Finally, fractures of the femur in children should be reduced by closed methods to restore angulation and alignment, but shortening should not be fully corrected in the presence of oblique or transverse fractures. In the case of spiral fractures which tend to shorten at the site of fracture during the healing period, full length should be restored.

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Experimental and Clinical Study of New Growth of Bone in a Cavity

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IT is suggested that the function of bone grafts is only "to keep soft tissue from filling the space, in which it is desired to grow bone." This is based on the observation that the presence of soft tissue prevents the growth of bone in the area. If the soft tissue can be kept from filling the space, bone will grow there just as well without as with bone grafts, and perhaps even better. It is known that before a fracture is finally united after the application of a bone graft, the graft must be absorbed and ultimately replaced by living bony tissue. Perhaps the grafts may even interfere with or delay this process. On the contrary, if sufficient space is afforded at the desired site, the experimental growth of bone is much more rapid in the absence of bone grafts.

The splinting effect of the grafts is usually of relatively little importance because it has been shown that most fractures and spinal fusions unite quite satisfactorily without internal splinting. Moreover, it has been well demonstrated that if a graft is made secure, for example in a spinal fusion, there is a greater probability of it fracturing; then the whole process of absorption of dead bone and replacement by new bone must take place. Therefore, it is suggested that if the graft is eliminated, this process might be accomplished in shorter time and with better effect. Also, more proper molding and a more appropriate size and density of new bone can be better controlled in the absence of grafts.

There are just three conditions necessary for the new growth of bone, aside from replacement and growth in the young. These are: (1) the presence of a blood clot, (2) preserved osteoblasts, and (3) contact with living tissue.

Grafts may be an adjunct but are not a necessity as a source of calcium because calcium is available from the circulation.

To have a hematoma, therefore, of the right size and shape and in the right position, it is necessary to prevent soft tissues from pressing in and displacing or molding the blood clot, either during its formation in the fluid and semi-solid state, or later on. If the clot is displaced or molded by the soft tissue, then obviously the bone formed will conform to that outline. Under these conditions there may be insufficient bone formed, especially in critical areas, or it may be absent if soft tissue comes into contact with the host bone. This sort of pressure by soft tissue will leave narrowed and constricted waist-like areas which are so often seen in those cases in which the bone grafts fracture.

These opinions are based on experimental evidence in which we demonstrated that by removing the periosteum and ruffing the surface of the bone, or better still by removing a portion of cortex (for example, over the ilium of a dog) and placing a cage of any sort above this, by which the soft tissues are kept out and a space is formed, this cavity will be filled completely by bone. This applies to the cortical bone of long bones, as well as to cancellous tissue and in spinal areas. Further experiments are in progress which suggest that gaps in long bones may be bridged by growth of bone between the ends, through a tunnel of adequate lumen, so arranged as to keep the soft tissues from filling the space.

Figures 1 to 3 demonstrate the results of the experiments from which this information was derived, and show the outcome of the application of this principle in spinal fusion in human patients.

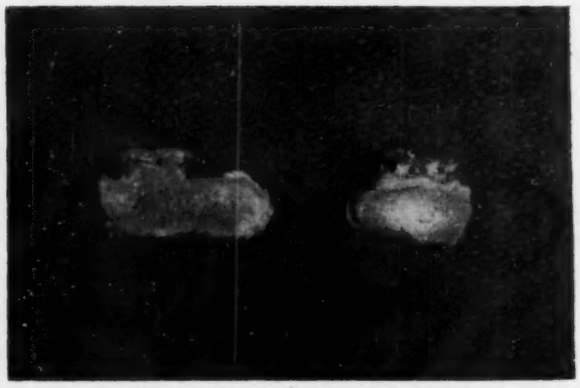


FIG. 1. Transverse section of ilium of dog showing new growth of bone projecting above old cortex and filling cage still in place.

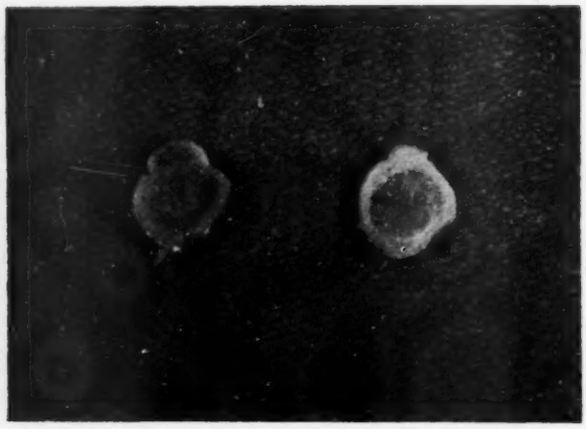


FIG. 2. Transverse section of femur of dog showing new growth of bone projecting above contours of shaft and filling cavity of cage now removed.

FIG. 3. Patient L. K. Lumbosacral fusion showing mass of new bone formed beneath roof of thin plates of autogenous bone.

EXPERIMENTS

The glutei muscles were reflected from an area on the outer surface of the ilium in dogs. A thin flake of the cortex was removed and over this area was placed a fenestrated cage made of plastic material This cage had to be of sufficient rigidity to withstand the pull and pressure of the gluteal muscles when they were resutured and of the fascia and skin over this. Cross section revealed the level of the cortical surface of ilium, then the plastic cage in position and the complete interior of this cage filled with newly formed bone, causing an elevation 6 mm. above the level of the surrounding bone. (Fig. 1.)

A microscopic section of this bone demonstrated that it was continuous with the substance of the host bone and that it had all the characteristics of newly formed cancellous and beginning cortical bone.

Figure 2 shows a cross section of a femur of a dog in which the surface of the cortex was bared of muscle and periosteum and a plastic cage placed over this. The muscles, fascia and skin were sutured; after a ten-week interval the specimen was recovered. Cross section shows the outline of the cortex and medulla of the femur, and in addition to this, the new growth of bone elevated up to a height of 5 mm. There seemed to be almost no limit to the level at which bone would form under such a cage. The limiting factor in such cases was determined by the size of the cage which could be accommodated beneath the muscle and fascia tissue so that it would not cause too much pressure and ulcerate through to the skin. Microscopic section showed the new growth of bone continuous with the original cortex and the beginning formation of what appears to be a second medullary cavity within. Another cortical layer superficial to it has formed practically in contact with the cage above.

Such a cage placed over an area on the spinal column simulates the conditions produced in spinal fusion. The spinous processes were trimmed off and the lamina freshened; then the cage was placed over this area and the muscle fascia and skin sutured over the top.

Having arrived at this stage, it was thought

that perhaps a portion of a shaft of bone could be grown, using these principles. Accordingly, a portion of fibula was excised and a plastic tube placed so that the remaining ends of the fibula fitted into each end of the plastic tubing. The end result of these experiments will be reported later.

From this latter experiment, it would appear that the cavity made by the cage or tube, if in contact with bone, will become filled with new bone. It was thought originally that perhaps a network or cage which is perforated, thereby giving contact with surrounding tissues, might encourage the vascularization and growth of bone. However, with this tube in the fibula, it would appear that perhaps the contact with surrounding vascular tissue, except at the ends, is not necessary.

The practical application of this principle has been used in performing spinal fusions of the lumbosacral area in fifty-six human patients. The plan has been to prepare the area and then to cut multiple thin grafts from the tibia. These are placed as a roof, which might be termed a cage, over a large cavity in the lumbosacral area. The purpose is to use these grafts, which are not fixed, as the surface of the cage, not for any specific virtue in the grafts themselves but as the outer barrier of the cage. These ultimately will be absorbed and, therefore, will not have to be removed as might plastic material. The principle, however, is the same as that used in the experimental animals, namely, the grafts are applied to keep the soft tissue out of the area so that it can be filled with bone. Figure 3 shows the effect of the growth of bone under such conditions.

SUMMARY

The growth of new bone in a cavity has been explored experimentally and applied clinically.

Acknowledgment: We gratefully acknowledge the financial support of Mr. Percy Gardiner, of the institute bearing his name, to this project; also the assistance of Mr. N. Korponay, Miss E. DeCock and Miss E. Kerr.

Boxer's Knuckle

A PRELIMINARY REPORT

J. ROBERT GLADDEN, M.D., *Washington, D. C.*

THE literature contains many articles on the impairment of function of the tendons of the hand. This impairment might have resulted from an injury such as traumatic severance or rupture of the tendon, from poliomyelitis or from some other disease or irritative process. Many procedures have been utilized to improve the function of the hand when tendons have been bound down by scar tissue, or in instances in which the free motion of the tendon in its sheath has been affected. (Fig. 1A and B.)

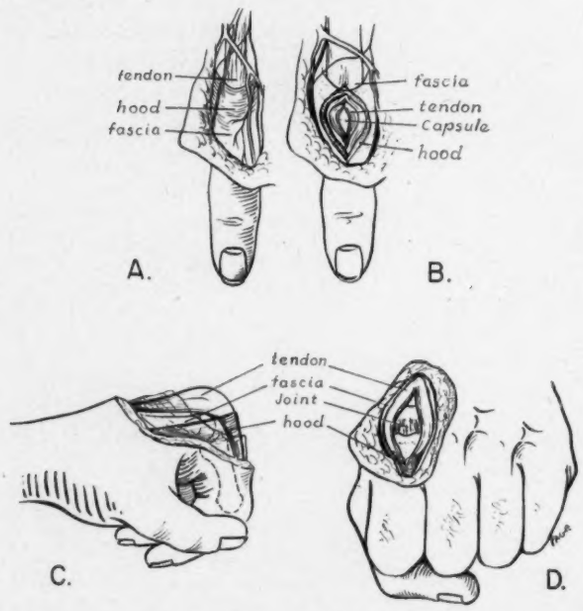


FIG. 1. A, normal knuckle showing extensor digitorum communis tendon, dorsal expansion hood and fascia.

B, normal knuckle showing section through fascia, tendon and dorsal expansion hood down to capsule over joint. The capsule blends with a part of the deep portion of the extensor tendon that inserts into the base of the first phalanx.

C, diagrammatic drawing of lateral view of the injured knuckle in Case 1 at the time of surgery, showing thickened fascia and enlarged tendon. The proximal portion of the dorsal expansion hood is also thicker than normal.

D, diagrammatic view of boxer's knuckle in Case 1 at the time of surgery, showing the diamond-shaped defect extending down to the metacarpophalangeal joint. The polyps noted at surgery are not shown.

The ultimate objective of all treatment has been to improve function in regard to motion and to overcome weakness. There is a paucity of material on the pathology of injured knuckles in which tendons are involved as a result of repeated direct trauma. There is even less information available as to the surgical treatment of these knuckles which will permit prize fighters to continue in their profession.

Many terms have been used in the description of these hands such as "brittle," "water on the joint" and "bursitis." The disability is usually progressive. Initially, a boxer uses the hand to defend himself and picks out soft spots to punch. His opponent soon recognizes this weakness and capitalizes on it. A top-ranked fighter may box as usual for a few rounds until his hand is reinjured, and then suddenly he is severely beaten. He tries to win by an early knockout, because his chances of winning diminish as the fight is prolonged. The fighter begins to lose to mediocre boxers, makes smaller fees, and may eventually have to give up boxing completely.

This might be a factor in the explanation for a few of the serious injuries sustained in the boxing profession. It is certainly not difficult to understand how a boxer would be able to deal harder and more effective punches if his opponent begins suddenly to push with one of his hands instead of punching. Fighters who have injured hands are reluctant to seek treatment. In most instances they have been advised to give up boxing and seek some other means of employment. Physically, they are usually

able to do anything that does not produce direct pressure over the affected joint.

CASE REPORTS

CASE 1. This patient, a heavyweight, first injured his hand in a bout in 1947. The metacarpophalangeal joint of the index finger of his right hand became painful during the bout and the pain continued as he attempted to punch. After this bout he noted that the joint was markedly swollen. The swelling subsided following the use of hot soaks and brine soaks for approximately two weeks. The fighter was careful not to injure his hand while training for his next bout. In the next professional fight, he struck his opponent on the elbow injuring the knuckle again. He was not able to punch with the hand for the rest of the bout because of extreme pain. The swelling noted in the region of the injured knuckle did not completely subside following treatment after this contest and became more pronounced after each fight. Regarded at one time as a hard puncher, he now began to spend most of his time defending himself during a fight. As time went on, he took more of a beating about his face and head. In his last fight, before being seen for surgery, he was unable to punch with his injured hand after the first round.

Examination in August, 1949, two months after a fight, revealed marked swelling about the second metacarpophalangeal joint of the right hand. The skin was freely movable over the joint and there were no scars. There was no limitation of motion of any of the joints of the finger. Point tenderness was noted over the knuckle.

The following findings were noted at surgery in September, 1949: (1) The skin immediately over the injured knuckle was about three times as thick as normal. (2) There was a diamond-shaped opening in the fascia directly over the tendon. The markedly thickened margins of this opening were adherent to the margins of a similar opening in the extensor tendon. Proximally, the edge of the soft tissue was thick in several places. A diamond-shaped tear of the extensor tendon, approximately 1.5 cm. in length, was noted directly over the head of the metacarpal where pressure would be greatest when the joint was in flexion. The tendon was about four times as thick as normal and felt like a piece of leather. The thickened portion of the tendon was approximately 2 cm. in length. There was some thickening of all components of the proximal 1 cm. of the extensor hood. (3) There was a smaller tear, similar in shape, of the thickened soft tissue beneath the tendon and above the capsule of the joint. The same opening was noted in the capsule and extended down to the cartilage over the end of the metacarpal bone. When the joint was flexed, the cartilage of the metacarpal bone in the region of the defect was somewhat bluish in color with several small denuded areas noted. The cartilage was somewhat friable about the margins of the denuded areas. A number of small, pinhead-sized polyps were noted in the joint where the synovial tissue was reflected from the dorsum of the metacarpal head. The polyps were bluish red in color. (Fig. 1C and D.)

At operation a straight incision was made over the radial aspect of the second right metacarpophalangeal joint, extending above and below the joint. Following exposure of the defect which extended down into the joint, a greater part of the scar tissue in the region of the edge of the defect was resected. The soft tissue adjacent to the tendon itself was dissected and undermined. The portion of the tendon-like tissue remaining was approximately $\frac{3}{16}$ inch in width. A portion of the expansion hood not involved in the defect, measuring approximately $\frac{3}{16}$ inch, was resected and fastened over the remaining tendon with very fine chromic catgut sutures. The fascia, which had been undermined over the region of the affected portion of the tendon, was approximated with sutures placed in such a manner that they would be away from the tendon proper.

Three weeks after surgery the patient had no pain or discomfort in the right hand. Approximately 15 degrees limitation in extension of the metacarpophalangeal joint was noted. The swelling had subsided considerably and was still diminishing. The boxer returned to the ring three months after surgery and had several successful fights. One year after surgery he began to complain of frequent headaches. The headaches were similar to those noted after he had been rather severely beaten about the head and face in the last few fights before the operation on his hand.

After a neurologic examination the patient was advised to discontinue boxing as a profession. At present, in addition to his regular job, he acts as a sparring partner to fighters training

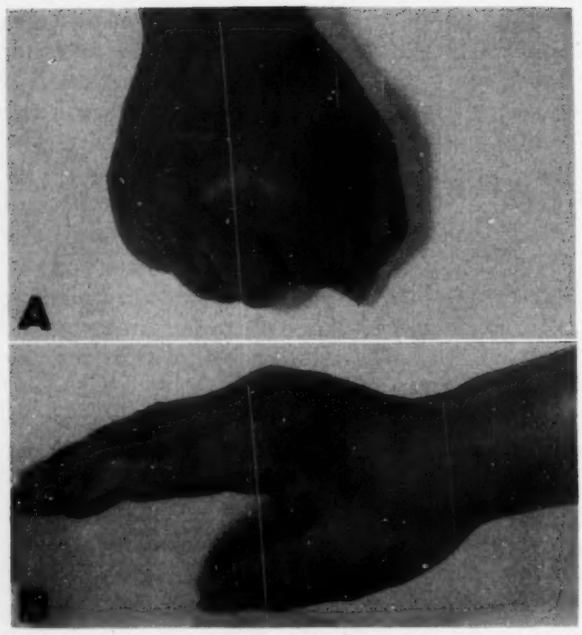


FIG. 2. Case 1. A, boxer's knuckle as seen on April 24, 1956. The knuckle is still larger than normal although three-fourths of the involved tendon in the region of the injury was resected at the time of surgery.

B, lateral view of boxer's knuckle in Case 1, showing no limitation of extension of the second metacarpophalangeal joint. The mallet deformity seen followed an injury ten years previously. There was rather pronounced limitation of flexion of the metacarpophalangeal joint for approximately six months after surgery.

for professional bouts. He has had no trouble with his hand since surgery. (Fig. 2A and B.)

CASE II. This patient, a light heavyweight, gave a history similar to that of the first patient. He sustained injuries to his second right metacarpophalangeal joint in September, 1949. The swelling of the joint was less than half that noted in the first case. The pressure of a bandage used in wrapping his hands caused pain and forced this boxer to stop fighting completely.

Examination in March, 1951, did not reveal any scars over the extensor surface of the injured knuckle. Some thickening of the skin could be noted, but there was no limitation of joint motion.

At surgery all soft tissue beneath the skin over the metacarpal head was markedly thickened. There was a small diamond-shaped tear 1.5 cm. in length in the soft tissue over the extensor tendon. The tissue was adherent to the tendon at the margins of the defect. Synovia-like tissue lined the defect which was smooth and discolored. The thickened edges of the tissue immediately adherent to the tendon seemed to be rolled under. (Fig. 3A and B.)

The knuckle of the middle finger of the right hand was exposed through an L-shaped incision. The soft tissue involved over the tendon was

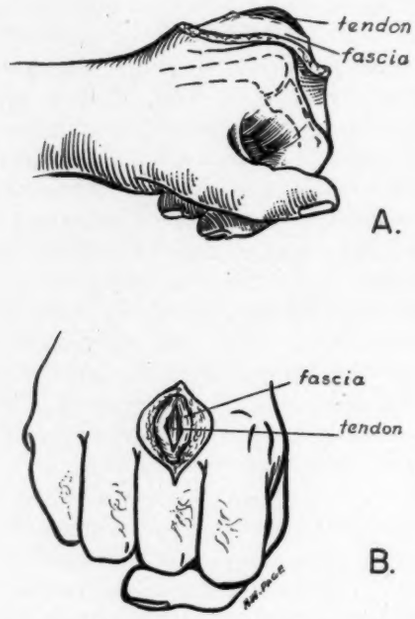


FIG. 3. A, diagrammatic drawing of lateral view of knuckle injury of boxer in Case II, showing thickened tendon and soft tissue over the tendon.

B, diagrammatic drawing of lateral view of injured knuckle in Case II, showing diamond-shaped defect over the injured third right metacarpophalangeal joint. The defect was limited to soft tissue and formed a bursa-like sac over the thickened tendon.

undermined, and the scar tissue was resected as far as possible. The soft tissue was imbricated over the thickened tendon. The metacarpophalangeal joint was immobilized for fifteen days.

After surgery all swelling about the joint subsided, and the patient was able to resume fighting in two months. Because of his punching ability, he had to begin accepting fights with heavyweights in order to get bouts. In 1952 while acting as a sparring partner for a heavyweight boxer, he sustained a cerebral concussion and was advised to stop boxing. In the early part of 1956 this boxer started training again and was scheduled for an early return to the ring as a heavyweight fighter. He had a normal range of motion of the involved metacarpophalangeal joint, and had no weakness of

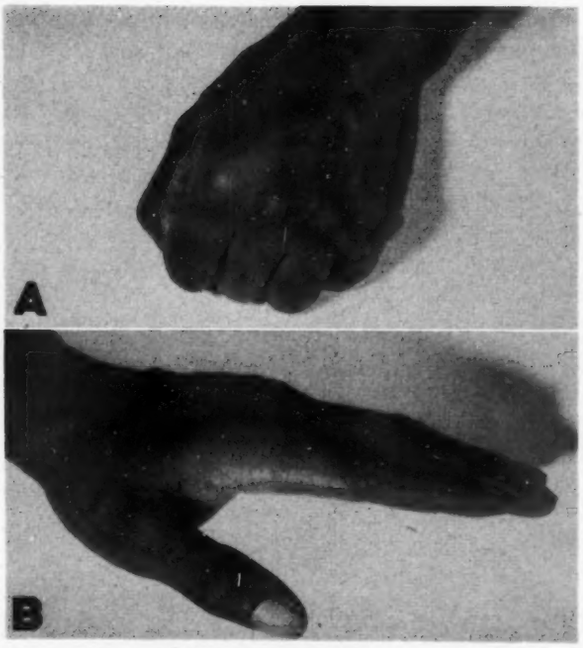


FIG. 4. A, knuckle of boxer in Case II as observed on April 23, 1956. He had been in training for approximately six weeks preparing for a return to the ring. Films were made after approximately six rounds of sparring with the fighter discussed in Case I.

B, lateral view of knuckle of boxer in Case II, showing no limitation of extension of the metacarpophalangeal joint.

extension of any of the joints of the finger against resistance. (Fig. 4A and B.)

CASE III. This patient, a heavyweight, gave a history somewhat similar to that of the previous boxers, except that both hands were involved. He reinjured both hands early in a fight in 1951. Following this bout, he found that any pressure against the injured knuckles of his hands produced pain, even after a reasonable rest period following a fight; and there was no decrease in swelling about either involved joint. He was unable to punch even the softer bags without discomfort. At this time he had considered giving up boxing as a career.

Examination in November, 1951, revealed marked swelling over the third metacarpophalangeal joint of the right hand. It was possible to palpate a depression in the middle of the swollen area about the affected metacarpophalangeal joints of both hands. Some free fluid could be palpated in the defect over the right knuckle. Pressure over the involved knuckle of the right hand produced more pain than on the left. There was no limitation of motion of either joint. At operation in December, 1951, a diamond-shaped tear about 1 cm. in length was noted in the thickened tissue over the affected tendon of the left hand. The edges of tissue at the margins of this tear were about 0.5 cm. thick. The tendon was about three

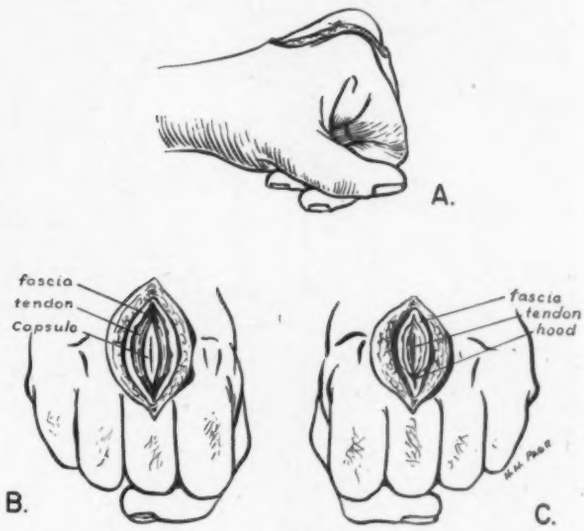


FIG. 5. Diagrammatic drawings of injured knuckles of boxer in Case III. A, lateral view showing thickening of all tissue over middle metacarpophalangeal joint.

B, view showing diamond-shaped defect of right hand. The defect extends through some of the transverse fibers of the dorsal expansion hood and extends into the deep portion of the extensor tendon to the first phalanx, which blends with the thickened capsule.

C, view showing the diamond-shaped defect of the injured knuckle of the left hand. The defect extends down into the thickened extensor digitorum communis tendon, but not into the deep portion of the tendon or capsule.

times its normal size and felt like a piece of leather. A diamond-shaped defect was present in the tendon which did not extend through completely. There was also some thickening of the capsule beneath the involved portion of the tendon.

A somewhat larger diamond-shaped tear was noted in the thickened tissue adherent to the affected tendon of the right hand. At one point along the edge of the tear the tissue was 0.6 cm. thick. There was a diamond-shaped tear in the thickened tendon similar in shape and size to the defect above it. A much smaller defect was noted in the thickened capsule, but it did not extend into the joint proper. (Fig. 5A, B and C.)

At the first operation both knuckles were exposed through an L-shaped incision. The

operative procedure on the joints was similar to that in Case I. In all instances as much scar tissue as possible was resected. A considerable amount of tendon substance was sacrificed at operation.

Because of the extensive scar tissue in all the tissues involved over the right knuckle, a second operation through the same incision was performed in February, 1952, approximately two weeks after the first procedure. Additional scar tissue was removed, leaving only a small piece of string-like tendon. The remaining part of the tendon was reinforced with portions of the expansion hood removed from both sides of the joint. Imbrication of soft tissue over the tendon was done in all instances.

This boxer returned to the ring eight months after surgery. He has participated in twenty-four bouts, losing three.

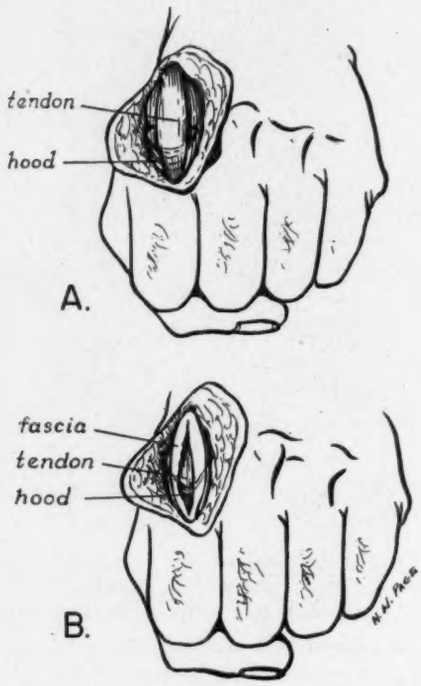


FIG. 6. A, diagrammatic drawing of a knuckle showing type I knuckle injury with thickening of tissue over tendon and enlargement of the tendon. There is no tear in any of the structures.

B, type II knuckle injury showing thickening of all tissue over the joint with a diamond-shaped defect in fascia over the tendon. There is no tear of the tendon or of the dorsal expansion hood. The tendon is usually markedly enlarged in this instance.

CASE IV. This patient, a light heavyweight, was first seen in January, 1948. He had first injured his right hand in a bout in September, 1947. He later participated in several bouts with slight swelling noted over the knuckle after each fight. The swelling usually subsided after hot soaks for a few weeks. Following a bout in January, 1948, the swelling over the third metacarpophalangeal joint of his right hand did not subside after the usual hot soaks and remained sensitive to pressure.

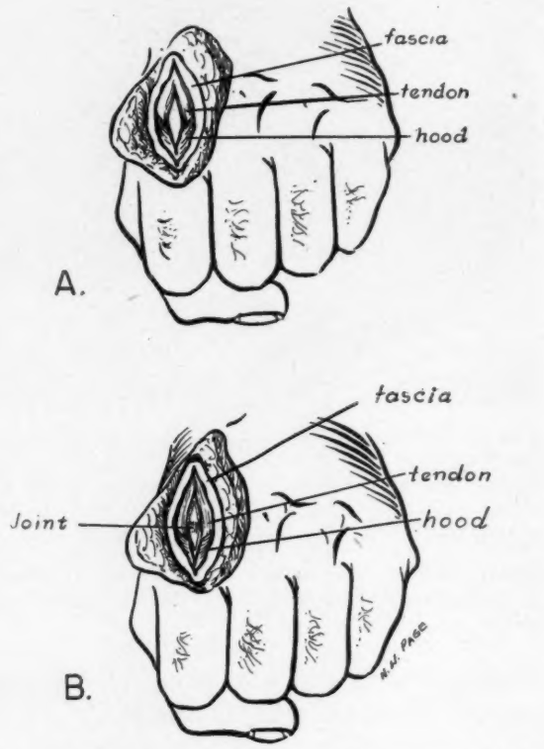
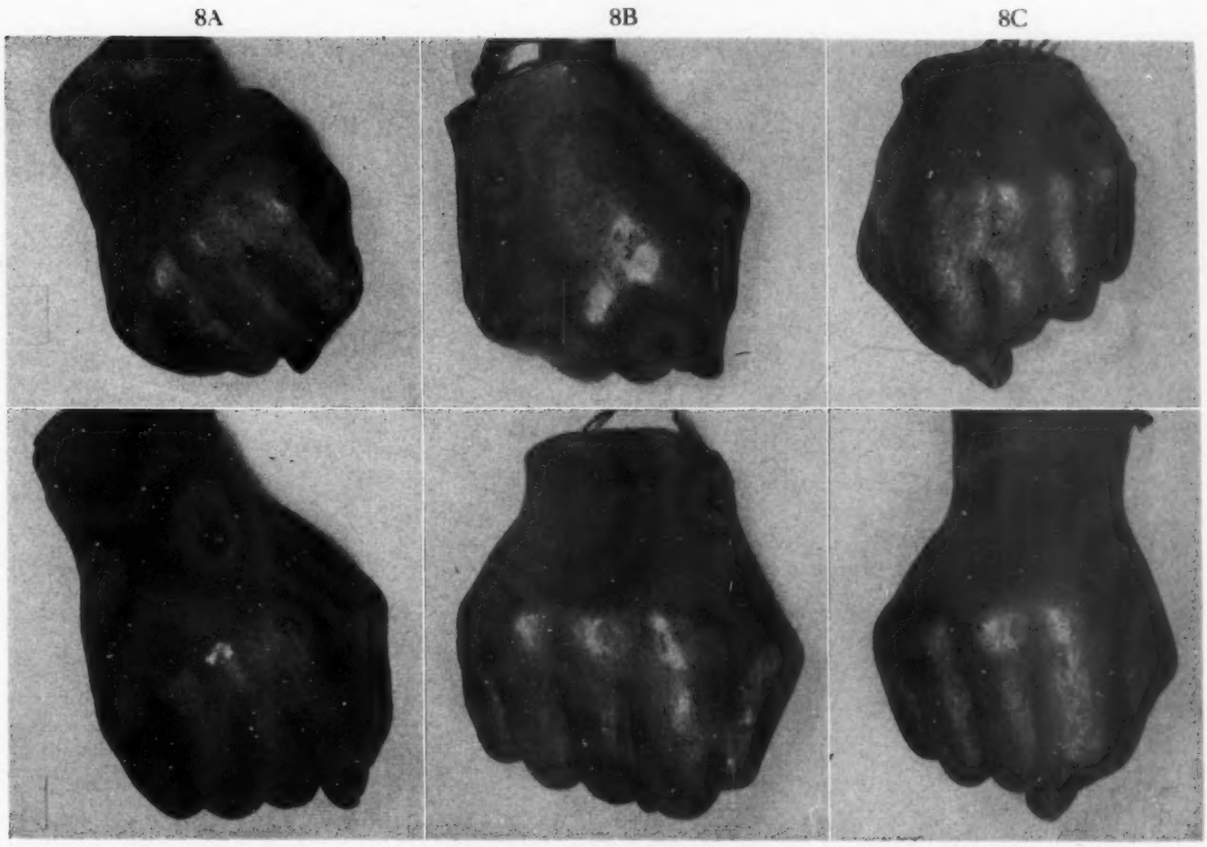


FIG. 7. A, diagrammatic drawing of type III knuckle injury showing thickened tissue over joint. The diamond-shaped defect extends down to the blended deep portion of the extensor tendon and joint capsule. The tear also involves the proximal transverse fibers of the dorsal expansion hood.

B, type IV knuckle injury showing diamond-shaped defect which extends through blended deep portion of the extensor tendon and capsule down to the joint proper.

Examination in April, 1949, revealed some thickening of soft tissue over the third metacarpophalangeal joint, but no defect could be noted. A small amount of free fluid was palpated. Very little tenderness was noted on pressure over the affected joint. The swelling gradually diminished after conservative therapy. He was advised regarding the wrapping of his hands both in training and during pro-



8A 8B 8C

8D 8E 8F

FIG. 8. A, mould of fist of a former lightweight champion. This fighter was one of the last of the bare knuckle champions. All of his knuckles are enlarged. Swelling of the second and fourth knuckles appears more pronounced. Swelling in the region of the metacarpophalangeal joint of the thumb and base of the first metacarpal bone is also noted. A deformity suggestive of a Bennett type fracture-dislocation might have been present. The wrist is also enlarged. This fist shows deformities following severe repeated trauma to knuckles, including the thumb and the base of the first metacarpal bone.

B, mould of fist of a former featherweight champion. The enlargement of the knuckle over the second metacarpophalangeal joint is rather pronounced. There is also some enlargement of the knuckle of the third metacarpophalangeal joint.

C, mould of fist of a former featherweight champion. There is enlargement of the knuckle over the second metacarpophalangeal joint.

D, mould of fist of a former lightweight champion. There is enlargement of the knuckles over the second and fourth metacarpophalangeal joints.

E, mould of fist of a former heavyweight champion. The enlargement of the knuckle over the third metacarpophalangeal joint was not very pronounced.

F, fist of a former bantamweight champion and former American flyweight champion. There is enlargement of the knuckles over the second and third metacarpophalangeal joints.

fessional bouts. I have seen his hands subsequently on several occasions; they have caused him very little trouble. He has lost three fights of a total of fifty-two since April, 1948, and at no time has his punching power been affected by pain in a knuckle. This boxer realizes the importance of wrapping his hands and usually does this himself.

COMMENTS

A number of metacarpophalangeal joints were explored surgically after a single trauma. There was marked swelling of soft tissue over the affected joints and x-rays revealed impacted fractures of the neck of metacarpal bones. There was palmar angulation of the distal fragment in all instances. The edema of

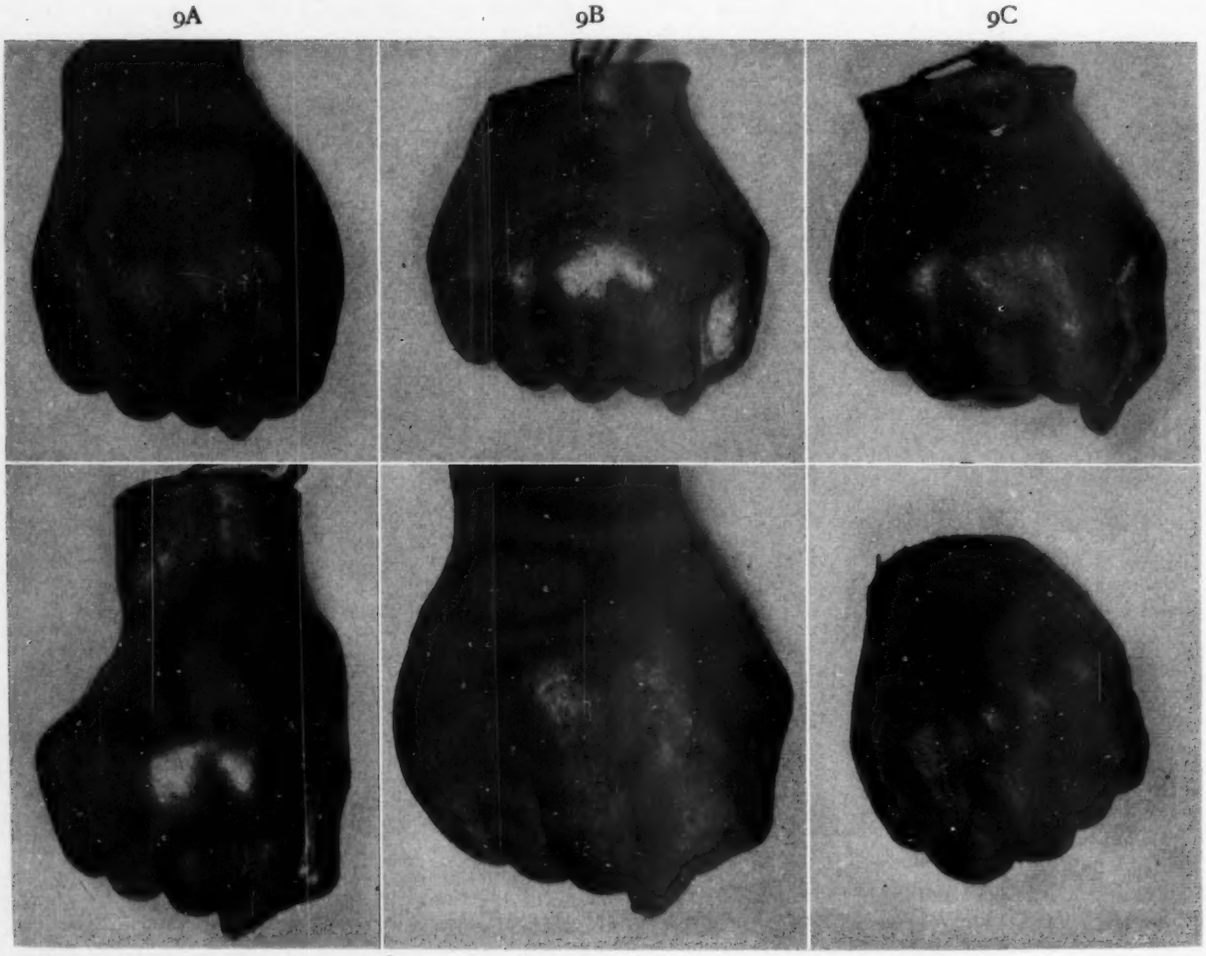


FIG. 9. A, fist of a former middleweight champion. There is enlargement of the knuckle over the second and fourth metacarpophalangeal joints. The knuckle over the fourth metacarpophalangeal joint seems more pronounced.

B, fist of a former bantamweight champion showing enlargement of the knuckles over the second and third metacarpophalangeal joints.

C, fist of a former featherweight champion showing enlargement of the knuckle over the second and fourth metacarpophalangeal joints.

D, fist of a former bantamweight champion showing enlargement of the knuckles over the second and third metacarpophalangeal joints. The enlargement of the knuckle over the third metacarpophalangeal joint is more pronounced.

E, fist of a former heavyweight champion showing enlargement of the knuckles over the second and third metacarpophalangeal joints. One can appreciate by proportion the tremendous size of this fist.

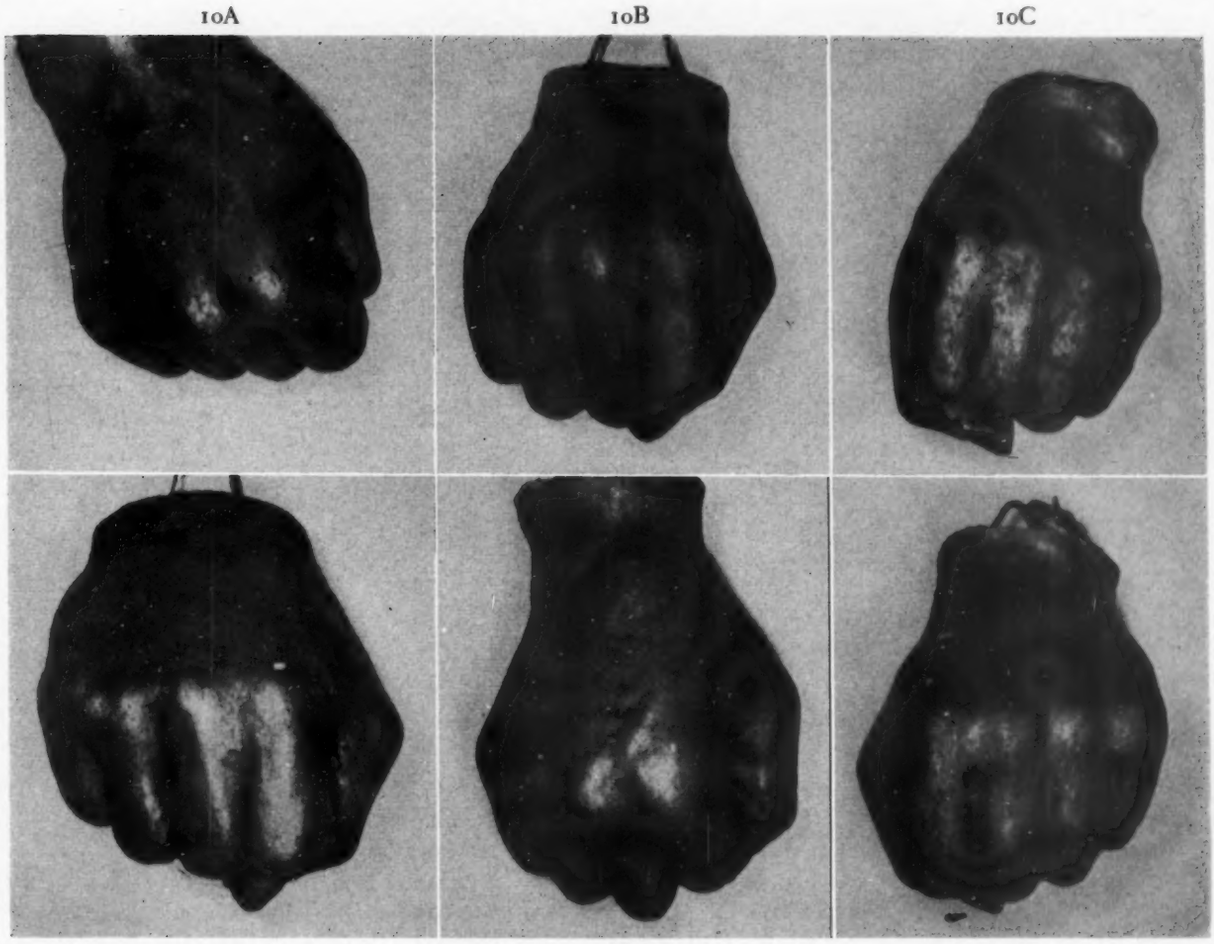
F, fist of a former welterweight champion showing enlargement of the knuckles over the second and fourth metacarpophalangeal joints.

soft tissue and capsule subsided following intramedullary fixation of fracture and immobilization. None of these patients has had any further swelling, pain or any specific discomfort since his discharge.

On the basis of the operative findings and follow-up studies on injuries to knuckles of several fighters, the following classification is presented. In all instances there was swelling about the affected knuckle and thickening of the soft tissue.

Type I. Thickening of soft tissue, including the tendon and capsule over the distal end of the metacarpal bone, with no evidence of a tear. (Fig. 6A.)

Type II. Thickening of soft tissue, tendon



10A 10B 10C

10D 10E 10F

FIG. 10. A, fist of a former welterweight champion showing pronounced enlargement of the knuckle over the second metacarpophalangeal joint with less enlargement of the knuckle over the third metacarpophalangeal joint.

B, fist of a former featherweight champion, welterweight champion and lightweight champion. There is enlargement of all knuckles except over the fifth metacarpophalangeal joint. Enlargement of the knuckle over the second metacarpophalangeal joint was more pronounced.

C, fist of a former bantamweight champion. There is enlargement of the knuckles over the second and third metacarpophalangeal joints.

D, fist of a former heavyweight champion showing some enlargement of the knuckle over the second metacarpophalangeal joint which was not too pronounced when the mould was made.

E, fist of a former lightweight champion showing enlargement of the knuckles over the second and third metacarpophalangeal joints.

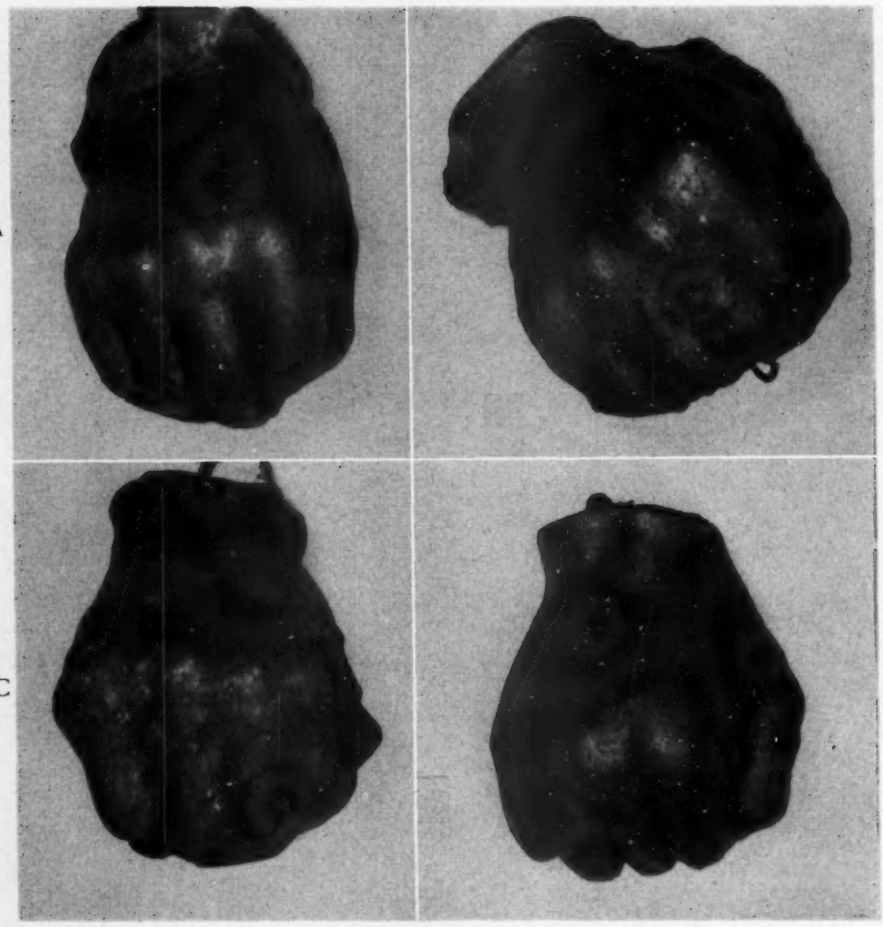
F, fist of a former welterweight champion showing only slight enlargement of the knuckles over the second and fourth metacarpophalangeal joints.

and capsule over the affected joint, with tear of the more superficial portion of the soft tissue. (Fig. 6B.)

Type III. Thickening of soft tissue, tendon and capsule over the affected joint, with tear of soft tissue and tendon. (Fig. 7A.)

Type IV. Thickening of soft tissue, tendon and capsule, with tear of these structures; the defect extending into the joint space. (Fig. 7B.)

It is possible to treat a Type I injury conservatively. If a boxer is careful in wrapping his hands, further disability should be minimal. It is also possible to treat an early Type II injury with a small defect in tendon sheath as a Type I injury. In the latter instance, the



11A 11B 11C 11D

FIG. 11. A, fist of a former welterweight champion showing enlargement of the knuckles over the second and third metacarpophalangeal joints with slight enlargement of the knuckle over the fourth metacarpophalangeal joint.

B, fist of a former middleweight champion showing pronounced enlargement of the knuckle over the second metacarpophalangeal joint.

C, fist of a former featherweight champion showing pronounced enlargement of the knuckle over the second metacarpophalangeal joint.

D, fist of a former lightweight champion. There is pronounced enlargement of the knuckles over the second and third metacarpophalangeal joints.

swelling will continue to persist to some degree and some discomfort will follow punches on bony prominences such as the head, elbow and shoulder.

In all instances where a diamond-shaped tear exists in Type II, Type III and Type IV injuries, surgery offers the best prognosis.

Some views of moulds of famous boxers' hands, made by Dr. Walter Jacobs, are shown. In many instances there is obvious swelling about the knuckles indicating a residual of a knuckle injury. A study of the fighter's record in the ring might give some indication as to the time when the affected knuckles were influencing the outcome of his bouts. (Figs. 8, 9, 10 and 11.)

SUMMARY

1. An evaluation of the amount of information available on injuries to boxers' hands has been presented.

2. Cases have been reported with the gross pathology noted at operation on the knuckles of three prizefighters, with the activities of each fighter following surgery.

3. One case has been mentioned in which only conservative and non-operative treatment was utilized with a satisfactory end result.

4. Findings in instances of a single severe trauma to a knuckle have been given with follow-up findings.

5. A classification of injuries to boxers' knuckles has been attempted on the basis of limited observations. A more complete classification should be possible after further investigation.

6. The type of injury that can possibly be treated without surgery has been indicated.

Many of the injuries to boxers' knuckles are related to the improper wrapping of their hands while in training or for a scheduled bout.

Any operative technic used will depend on the gross pathologic findings in each injury.

Acknowledgment: I wish to express my appreciation for the persistence of Mr. John Carter. Even a poor preoperative prognosis of almost complete disability did not affect his request that something be done for the boxer in Case 1.

The moulds of the "fighting fists" were made by Walter H. Jacobs, D.D.S., of New York City, who gave permission to have them photographed.

We recommend:

"Controlled Hypotension" in Anesthesia and Surgery (American Lecture Series). By David M. Little, Jr., M.D., Department of Anesthesiology, Hartford Hospital; Assistant Clinical Professor of Anesthesiology, Yale University School of Medicine. 159 pages. Springfield, Ill., 1956. Charles C Thomas. *Price* $4.50.

Obstetric Practice. By Harold Speert, M.D., Associate in Obstetrics and Gynecology, Columbia College of Physicians and Surgeons; and Alan F. Guttmacher, M.D., Director of the Department of Obstetrics and Gynecology, Mount Sinai Hospital, New York. 478 pages. New York, 1956. Landsberger Medical Books, Inc. Distributed by The Blakiston Division of the McGraw-Hill Book Co. *Price* $7.00.

Abdominal Trauma

A STUDY OF 297 CONSECUTIVE CASES

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ABDOMINAL trauma is an uncommon surgical emergency. Nevertheless, it is serious and many important problems in management may arise.

TABLE I
ETIOLOGY

Type of Injury	No. of Patients	Per cent
Non-penetrating	230	77.5
Penetrating	67	22.5
Total	297	100.0

Since 1943 there has been a changing emphasis on the various features of abdominal injuries. Interest in this subject was aroused during World War II and many articles appeared which reported experiences with large numbers of war injuries. In this period mortality rates fell dramatically from about 50 per cent to 25 per cent and below [1,2,3]. This was due to many factors, including: (1) a better understanding of the nature of hemorrhagic shock and the provision of facilities for its treatment, (2) early operative treatment in most cases, (3) improved pre- and post-operative care, (4) improved surgical technics in the management of some specific injuries, and (5) selective use of antibiotics.

Immediately after the war many analyses were made of civilian experiences in specific abdominal injuries [3–20]. This discussion will present an over-all picture of abdominal trauma as seen in an active emergency service since 1946.

MATERIAL

Between January 1, 1946 and December 31, 1953, a total of 297 patients were admitted to Hurley Hospital with abdominal trauma. Genitourinary tract and pelvic visceral involvement were considered with intra-abdominal structures since the causative factors and diagnostic problems are similar. Because of the difficulties of diagnosis, injuries to the abdominal parietes are also included.

During this period there were 141,044 total hospital admissions and 13,250 admissions for trauma. Thus, abdominal trauma comprised only 0.2 per cent of all patients and 2.2 per cent of patients entering the hospital because of injury.

ETIOLOGY

Classification of patients was considered on the basis of whether the injury was penetrating or non-penetrating. These differ in many respects. War injuries are predominantly penetrating while those in a civilian community are more often non-penetrating. In this series 230 patients, 77.5 per cent of the total, were in this latter group. (Table I.)

The patient with abdominal trauma is most likely to be a healthy, young, male adult. Males predominate 3 to 1 and 68 per cent were between the ages of ten and thirty-nine. (Table II.)

Causes are shown in Table III. All but five of the penetrating injuries were due to gunshot or stab wounds, the majority of which occurred in brawls. One of the five was the result of a suicide attempt. Vehicular accidents accounted for 70 per cent of the non-penetrating injuries. This is in contrast to older statistics which indicated falls to be the most frequent cause.

TABLE II
AGE AND SEX INCIDENCE

Age (yr.)	No. of Patients	Per cent
0–9	30	10.1
10–19	66	22.2
20–29	83	28.0
30–39	53	17.9
40–49	27	9.0
50–59	19	6.4
60–69	12	4.0
70–79	6	2.0
Over 80	1	0.4
Total	230	100.0
Male	224	75.4
Female	73	24.6
Total	297	100.0

TABLE III
CAUSES

Type of Injury	No. of Patients	Per cent
Penetrating Injuries		
Gunshot wounds:		
Shotgun 13		
Rifle 7		
Pistol 13		
Not specified 4		
Total	37	55.2
Stab wounds	25	37.3
Falls on sharp object	3	4.5
Miscellaneous	2	3.0
Total	67	100.0
Non-penetrating Injuries		
Automobile accidents	122	53.0
Struck by vehicles	31	13.5
Motorcycle accidents	3	1.3
Bicycle accidents	4	1.7
Falls	19	8.3
Brawls	13	5.7
Industrial accidents	18	7.9
Football	3	1.3
Children at play	9	3.9
Other	8	3.4
Total	230	100.0

TABLE IV
VISCERAL AND NON-VISCERAL INJURIES

Type of Injury	No. of Patients	Per cent
Penetrating Injuries		
Visceral	39	58.2
Non-visceral	28	41.8
Total	67	100.0
Non-penetrating Injuries		
Visceral	125	54.3
Non-visceral	105	45.7
Total	230	100.0

TYPES OF INJURIES

Injury to intra-abdominal viscera occurred in 58 per cent of the group with penetrating injuries and 53 per cent of the non-penetrating group. (Table IV.) Non-visceral injuries in 133 patients (28 with penetrating and 105 with non-penetrating injuries) were to the abdominal wall only. Possibly some of these had minor intra-abdominal trauma in the form of contusions or even small lacerations of solid viscera or outer layers of hollow viscera.

TABLE V
VISCERA INVOLVED IN ABDOMINAL TRAUMA

Viscus	Penetrating Injuries		Non-penetrating Injuries	
	No. of Patients	Per cent	No. of Patients	Per cent
Spleen	4	6.0	29	12.6
Pancreas	1	1.5	2	0.9
Liver	11	16.5	18	7.8
Gall bladder	1	1.5	0	0.0
Stomach	9	13.5	3	1.3
Duodenum	0	0.0	1	0.4
Jejunum-ileum	16	24.0	19	8.2
Colon	13	19.5	9	3.9
Rectum	1	1.5	0	0.0
Diaphragm	7	10.5	7	3.9
Kidney	6	9.0	31	13.5
Bladder	6	9.0	21	9.1
Ureter	1	1.5	0	0.0
Vagina	1	1.5	0	0.0
Uterus	0	0.0	1	0.4
Broad ligament	0	0.0	1	0.4
Retroperitoneal vascular only	1	1.5	7	3.0
Single viscus injury	25	37.3	198	86.1
Multiple viscus injury	42	62.7	32	13.9

The frequency of organ involvement differs. (Table v.) In penetrating wounds, the gastrointestinal tract and liver were most commonly injured. This is more or less proportional to the mass of the viscus. Patients with non-penetrating trauma suffered injuries most commonly

TABLE VI
ASSOCIATED INJURIES

Associated Injury	No. of Patients	Per cent
Penetrating Injuries—Surgical Cases		
Craniocerebral	0	0.0
Thoracic	5	62.5
Extremity	3	37.5
Spine and pelvis	0	0.0
Total	8	17.0*
Non-penetrating Injuries—Surgical Cases		
Craniocerebral	17	47.2
Thoracic	22	61.1
Extremity	21	58.9
Spine and pelvis	1	2.2
Total	36	41.0†
Non-penetrating Injuries—Deaths (Non-surgical Cases)		
Craniocerebral	11	68.7
Thoracic	11	68.7
Extremity	4	25.0
Spine and pelvis	0	0.0
Total	16	88.0‡

* Of 67 patients
† Of 82 patients
‡ Of 18 patients

to the kidney and spleen. Of small intestinal injuries, 75 per cent were at points within 18 inches of either the ligament of Treitz or the ileocecal junction. Apparently the susceptibility of organs to injury is dependent in great part on their elasticity, fixation and proximity to bony structures.

Involvement of more than one viscus occurred in 62 per cent of the patients with penetrating injuries and in only 14 per cent of the non-penetrating group.

ASSOCIATED INJURIES

Associated injuries are important from the standpoint of diagnosis and treatment. (Table VI.) This is particularly true in non-penetrating trauma. Forty-one per cent of those operated upon in this latter group and 88 per cent of those who died without operation had significant associated injuries. This is less frequent in penetrating abdominal trauma which occurred in only five cases of thoracoabdominal gun-shot wounds and in three patients with major extremity injury to bone or major blood vessels.

TABLE VII
SHOCK

Type of Injury	Degree of Shock				Per cent in Shock
	None	Mild	Moderate	Severe	
Penetrating injury (Surgical cases)	15	3	9	15	64.3
Non-penetrating injury (Surgical cases)	44	12	14	12	46.3
Non-penetrating injury (Deaths—non-surgical Cases)	6	3	1	8	66.7

SHOCK

Some degree of shock was present in the majority of patients with serious abdominal trauma. (Table VII.)

Shock, when associated with penetrating injuries, was apparent either on admission or soon thereafter. Twenty-three of the twenty-seven patients had gun-shot wounds. All four patients with splenic injuries, ten of eleven patients with hepatic injuries and four of six patients with renal injuries presented this finding. It was a factor in seven of the eight deaths.

Shock in the non-penetrating group was extremely variable. Other shock-producing trauma, such as fractures or thoracic injuries, was present in many. In addition to hemoperitoneum, contamination of the peritoneum with gastrointestinal contents or urine was a frequent cause. Shock contributed to 40 per cent of the deaths.

OPERATIONS

Early operative treatment of most intra-abdominal injuries has been accepted since World War I. With the acceptance of this concept the mortality rate fell from near 100 per cent in the early part of the war to 56 per cent later [2,3]. This principle has been thoroughly substantiated, although selection of patients for operation may prove difficult.

Forty-seven of the sixty-seven patients with penetrating trauma came to operation. (Table VIII.) Eight had either no intra-abdominal injury or injury of such a nature that operative treatment was not necessarily the treatment of choice. These have been labeled "diagnostic laparotomies." In most, an incision was made near the wound and penetration of the peritoneum determined from intraperitoneal inspection. If penetration was found, the abdomen was then systematically explored.

TABLE VIII
OPERATION

	No. of Patients	Per cent
Penetrating Injuries		
Surgery	47	70.0
(Diagnostic laparotomy—8)		
No surgery	20	30.0
Adequately evaluated 12		
Inadequately evaluated 8		
(Surgery necessary later—1)		
Total	67	100.0
Non-penetrating Injuries		
Surgery	82	35.7
(Diagnostic laparotomy—9)		
No surgery	142	64.3
Deaths—no surgery 18		
Visceral injuries—no surgery 28		
Abdominal wall injuries only 102		
Total	230	100.0

Twenty patients in this group were not operated upon. In eight adequate evaluation was questionable. One of these returned with signs and symptoms of a lacerated liver, thirty hours after out-patient examination, which required operation for the control of bleeding. The time lag between admission and operation ranged from twenty-five minutes to five hours (not considering the patient operated upon at thirty hours) and the average time lag was one hour, fifty-six minutes. (Table IX.)

Non-penetrating injuries present greater problems in determining necessity and time of operation as suggested by the average time lag of over fifteen hours. (Table IX.) Of eighty-two operations, nine were classified as "diagnostic laparotomies." (Table VIII.) Autopsy in eighteen patients who died without operation showed abdominal injuries of a type amenable to operative treatment. There were twenty-eight patients with a diagnosis of visceral injury who were not operated upon: seventeen had injuries to the kidney with self-limited bleeding, seven had bladder injuries without rupture, one had contusion of the stomach (manifested by one episode of hematemesis) and two had injuries localized to the substance of the liver.

TABLE IX
INTERVAL BETWEEN ADMISSION AND OPERATION

Type of Injury	Time between Admission and Operation
Penetrating injuries	1 hr. 56 min.
Non-penetrating injuries	15 hrs. 7 min.

MORBIDITY

Average hospital stay is shown in Table X. Minor injuries which initially may appear more serious will have rather rapid dissolution of signs and symptoms and will permit the patient's discharge from the hospital in two to three days. The longer period of hospitalization for open visceral injury is due to the greater problems in postoperative care and to more frequent secondary surgical procedures.

TABLE X
DURATION OF HOSPITALIZATION

Type of Injury	Average Days in Hospital
Penetrating Injuries	
Non-visceral	3.4
Visceral	24.2
Non-penetrating Injuries	
Non-visceral	2.8
Visceral	14.3

MORTALITY

There was a total of thirty-nine deaths. However, seven were due to other trauma and abdominal injuries were of such a minor nature

that correction would not have influenced the result. Thus, thirty-two deaths were due primarily, or in some significant part, to intra-abdominal injuries. This is an overall mortality rate of 10.8 per cent. The rate in 164 patients with visceral injuries was 19.5 per cent. Eight of the patients who died were in the penetrating group and all had had operative treatment. Twenty-four were in the non-penetrating group and eleven of these were operated upon. Only five patients did not have serious associated injury and four of these had gun-shot wounds. Hemorrhagic shock was a factor in seventeen deaths; one patient died in pulmonary edema due to too vigorous treatment of shock and three patients died of peritonitis.

Comparing "hind-sight" to "fore-sight" in the management of the various problems leading to death in this group, important factors were: (1) error in diagnosis or delayed diagnosis because of associated injuries, (2) shock inadequately treated, (3) delayed operation, and (4) inadequate operation.

TREATMENT

Analyses of the specific treatment of abdominal injuries would include almost as many descriptions as there were patients. Therefore, this discussion will concern only general problems in management.

Initially, evaluation and supportive measures must take place simultaneously. Treatment must be initiated to establish an adequate airway, arrest apparent hemorrhage and begin restoration of deficiency in peripheral circulation. A complete history should be obtained from the patient, companions, ambulance attendants and others. A thorough and systematic examination should be made and all injured persons should be disrobed regardless of the nature of their specific complaints. This is by no means the final examination. It must be repeated frequently until the condition is stabilized.

All penetrating wounds should be explored by direct vision (never by probing) to determine the extent of injury. This principle is most important.

Non-penetrating injuries require a more considered evaluation. Concommitant serious injury to head, chest or extremity is exceedingly common and confuses the abdominal diagnosis. Frequently serious intra-abdominal injury is not suspected initially, but becomes apparent a short time later. The detection and appraisal of concealed sites of damage are only properly accomplished by immediate attention and continued observation. Most important is repeated systematic examination at frequent intervals. The evaluation of abdominal pain associated with thoracic injury is often difficult. Re-examination after appropriate intercostal nerve blocks often is helpful. Until stabilization occurs it will be necessary to record pulse and blood pressure at fifteen to thirty minute intervals. Appropriate laboratory procedures are necessary. It may be necessary to repeat the cell count, hemoglobin and hematocrit determinations every three to four hours. Slow but steady internal bleeding may be manifest by a progressive fall in these values with little or no evidence of clinical shock.

X-ray examination of the abdomen, including an upright and left lateral decubitus when feasible, should be done. A negative interpretation is not significant. Helpful positive findings include: pneumoperitoneum, foreign bodies and abnormal soft tissue shadows. Fractures in ribs, pelvis and vertebrae will alert one to possible injuries of the liver, spleen, kidney and bladder. All patients should void or be catheterized to determine hematuria and if blood is present a bladder capacity test and/or a cystogram performed. Later, cystoscopy or pyelography may be indicated. Diagnostic paracentesis may be indicated in certain situations but only positive findings are significant.

Laparotomy is usually *not* indicated in the following situations: (1) Non-penetrating injuries apparently confined to the abdominal wall. (2) Subcapsular injury to the liver. Many lacerations of the liver will be self-controlled, but most often when there are signs of intraperitoneal bleeding from the liver, a diagnostic laparotomy is necessary to rule out other injury. (3) Injury to the bladder without perforation. (4) Injury to the kidney in the absence of severe hemorrhage or extravasation of urine. (5) It is held by some that penetrating injuries with small, slow velocity objects, such as an ice pick or bird-shot, will be spontaneously controlled and do not require immediate operation [21]. Experience in this series is inadequate to accept or reject this tenet, but the great variability between cause and injury sustained would suggest caution in establishing such a fixed principle.

Laparotomy is usually indicated in the following situations: (1) Penetrating wound of the abdominal wall. (2) Definite evidence of ruptured hollow viscus. (3) Probable internal injury with evidence of bleeding. (4) Ruptured urinary bladder. (5) Kidney injury with excessive bleeding or extravasation of urine. (6) Increasing or persisting abdominal pain, tenderness or rigidity. (7) Increasing pulse rate together with questionable evidence of intra-abdominal injury. (8) Persistent signs and symptoms of splenic injury even without signs of active bleeding. Late rupture of a contused spleen is common and serious.

When exploring the injured abdomen, bleeding points should first be sought and controlled, and then perforations of the intestinal tract considered. Bleeding is usually found in the root of the mesentery, the omentum or from the solid viscera. Bleeding from the liver should be controlled with mattress sutures and/or hemostatic packs when possible. Frequently this cannot be done because of the extent or inaccessible location of the injury. Gauze packing may be necessary despite the frequent complications of infection and secondary hemorrhage. Injury to the gall bladder is repaired with insertion of a T-tube. When this is not possible, a cholecysto- or choledocho-jejunostomy of the Roux Y type is best. Injuries to the pancreas or receptaculum chyli are not always serious. Usually, bleeding and flow of chyle may be controlled with suture.

Hemorrhage from mesenteric vessels may be controlled with transfixion ligatures. However, ligation of large vessels may embarrass the circulation to a portion of the intestine. If there is any question of viability an appropriate resection should be performed. Small perforations of the bowel are sutured. Large defects, or several small defects in close proximity, require resection of the segment with primary anastomosis. Extensive injuries to the colon, however, should be treated by exteriorization, the Mikulicz procedure being the one of choice. Anastomosis of the large bowel in the presence of any gross fecal contents must not be attempted. Injuries to the rectum usually require repair with proximal colostomy.

A ruptured diaphragm must be repaired and a transthoracic approach is the method of choice. An adequate exploration of the abdomen, except the pelvis, may be done through the chest.

Bladder perforations should be repaired from inside the bladder and a catheter inserted as a suprapubic cystotomy. Kidney injuries with serious bleeding or evidence of extravasation of urine require nephrectomy in most cases, after function of the other kidney has been determined. Occasionally, a repair of the kidney pelvis, suture of a laceration, or resection of a portion of the kidney may be performed.

Unless contraindicated by the poor condition of the patient, a thorough and systematic exploration of the abdomen should be made. Retroperitoneal explorations should be performed when indicated.

Indications for drainage are: (1) insecure closure of a hollow viscus, (2) insecure hemostasis, (3) relatively large amounts of foreign material or necrotic debris, and (4) extensive retroperitoneal dissection or extravasation.

Diligent postoperative care is essential. Fluid and electrolyte needs, antibiotics, stomach or intestinal intubation, and repeated measures to keep the tracheobronchial tree free from obstructing secretions are important.

Associated injuries may be dealt with according to their needs and the ability of the patient to tolerate desired procedures.

Postoperative complications must be treated as required. Most common of these are: wound, pulmonary, and fluid and electrolyte complications.

SUMMARY

An over-all picture of abdominal trauma as it has been seen in 297 patients in the past eight years has been presented. The discussion has included: etiology, types of injuries, associated injuries, shock, selection of patients for operation, morbidity, mortality, and a brief résumé of important factors in management.

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Surgery of the Diseased Horseshoe Kidney

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AWARENESS of the horseshoe kidney was well stated by Gutierrez: "The history of the horseshoe kidney is as ancient as creation itself, since it has its very origin in an embryological congenital malformation found from the earliest days of medicine and anatomical sections in cadavers" [*1*]. Many authors have dealt with the factors responsible for its occurrence, as well as its incidence, symptomatology and management. The problem of management continues to intrigue each succeeding generation of urologists.

Although the anomaly was described at an early period, it was not until 1888 that the first successful operation was reported. At that time Socin told of the removal of the hydronephrotic half of a horseshoe kidney [*2*]. From then until 1925, seventy-one unilateral nephrectomies of horseshoe kidneys were reported, according to Eisendrath, Phifer and Culver; their collection lists sixty-four nephrectomies done for hydronephrosis, tuberculosis and calculi, and seven for neoplasms [*3*]. Since 1925 at least nineteen such operations for neoplasm in horseshoe kidneys have been reported [*4–12*]; we performed this procedure on one patient with adenocarcinoma.

Symphysiotomy in horseshoe kidney has been undertaken less often. Martinow, in 1909, described division of the isthmus which was followed by complete relief of pain; he used a transperitoneal approach [*1*]. Two years later the transperitoneal approach was advised by Rovsing in his detailed description of a technic for symphysiotomy. In 1922 Papin reported the first successful division of the isthmus via extraperitoneal exposure [*13*]. It was not until 1931, however, that an effective division of the isthmus was recorded in this country; the operation was performed by Donohue, who employed an incision through the flank [*14*]. When Baker and Colston searched the literature on symphysiotomy in a horseshoe kidney in 1936, they were able to find only twenty-four cases; in at least eleven, operations were performed through the transperitoneal approach [*13*]. In 1940 Foley reported seven additional cases, in all of which he employed a lumbar incision and an extraperitoneal approach [*15*]. At least ten more papers dealing with surgery on the horseshoe kidney have appeared since that date; they include symphysiotomies, heminephrectomies and pyeloplasties.

In this report we wish to emphasize the advantages of the transverse abdominal transperitoneal approach to the horseshoe kidney and also the value of aortography, not only in the study and diagnosis of disease of this malformed organ but also in planning and carrying out surgical treatment. Brief reports of illustrative cases will be presented.

Between November, 1950 and July, 1954, eight patients with symptoms referable to or established disease of a horseshoe kidney were operated on by the consultant staff and residents in urology at the Veterans Administration Center, Los Angeles, and at the Harbor General Hospital, Torrance, California. One other patient, under the care of the general surgical service for an abdominal aneurysm, was discovered to have a horseshoe kidney.

The urologic studies indicated in renal disease were carried out in all patients with this anomaly. In a few of the more recent cases aortography was done also and proved of considerable aid in preoperative evaluation. It has been well established that a horseshoe kidney more often than not has an anomalous blood supply. The aortogram provides information as to the relationship of the normal and anomalous vessels

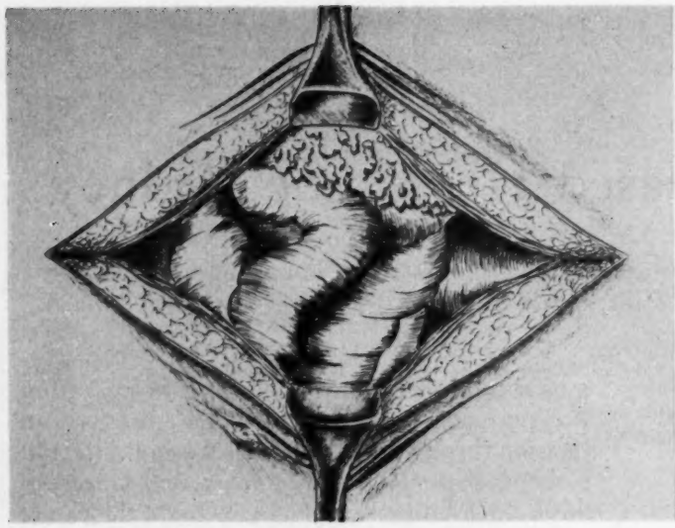

FIG. 1. Transverse abdominal incision.

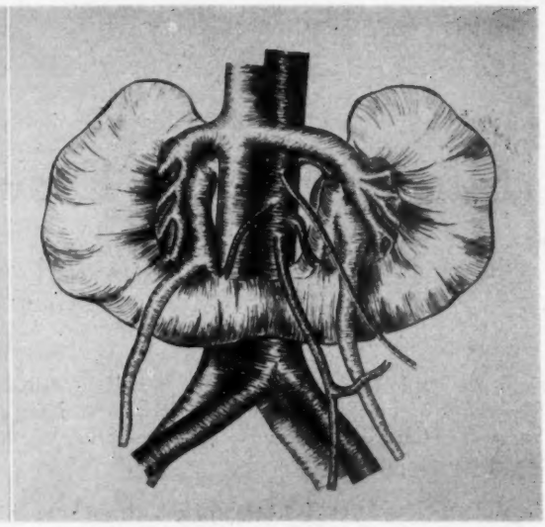

FIG. 2. Drawing of horseshoe kidney demonstrating anomalous vessels and relationship of all vessels to renal structures.

and also as to the distribution or absence of vessels to the isthmus. The surgeon, thus, is apprised of technical difficulties that may be encountered and can assess the feasibility of surgical correction more easily, and so shorten the operating time.

In all our patients preoperative indications were that a transperitoneal incision would constitute the most direct approach. This proved to be the case in every instance. The experience of others who have employed this approach substantiates its advantages.

SURGICAL TECHNIC

A transverse abdominal incision is made 2 to 3 cm. above the umbilicus. This is approximately in line with the isthmus of the horseshoe kidney which is usually situated at the level of the interspace between the third and fourth lumbar vertebrae. The incision is carried through the abdominal wall and the underlying abdominal contents are exposed. (Fig. 1.) The omentum, small intestine and transverse portion of the colon are retracted superiorly, while the ascending and descending portions of the colon are retracted laterally. The root of the mesentery proper is seen traversing the posterior abdominal wall from the left side of the second lumbar vertebra to the right sacroiliac articulation. Palpation of the isthmus can be accomplished through the mesentery. In our earlier cases the isthmus was exposed by mobilization medially of either the ascending or descending colon. During later operations it was found that this was not necessary and that the isthmus could be approached more directly through the posterior peritoneum, the latter being incised in an avascular area, directly over the isthmus.

The pulsation of the inferior mesenteric artery can be felt easily at this point; it should be avoided, and this can best be done by retracting it laterally to the left and superiorly. This vessel passes over, or anterior to, the isthmus.

The anterior leaf of the renal fascia is then encountered. This too is incised. As the dissection proceeds superiorly, the internal spermatic or ovarian vessels will be noted immediately below the renal vessels as they arise from the aorta or join the inferior vena cava or left renal vein. (Fig. 2.) The ureters usually pass anteriorly to the isthmus and are crossed by the spermatic or ovarian vessels. It is during the dissection just described that the value of the preoperative aortogram is appreciated. The anomalous vessels can be found more readily and their preservation or division accomplished. With the kidney freed from the surrounding structures, and especially from the underlying great vessels, the isthmus is divided. (Fig. 3.) Parallel rows of mattress sutures, or "cobbler's stitch," are placed adjacent to the thinnest and most avascular portion of the isthmus. The isthmus then is incised between the two rows of sutures. Bleeding is minimal and can be con-

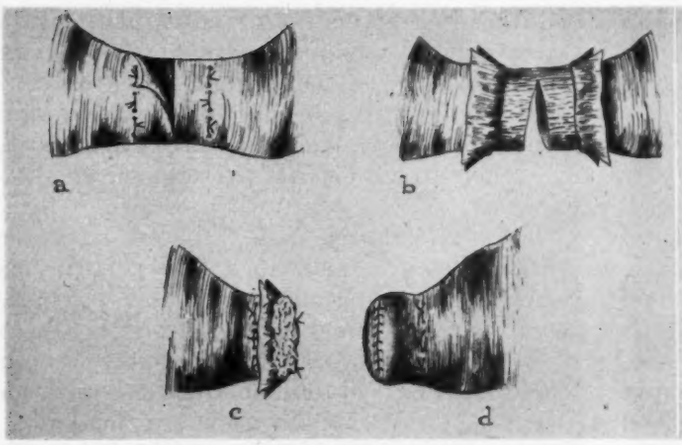

FIG. 3. Schematic representation of steps in symphysiotomy; hemostatic sutures, division of isthmus, hemostatic fat pad in place, closure completed.

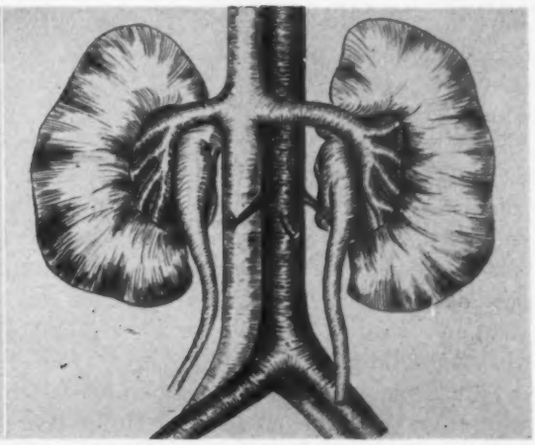

FIG. 4. Position of kidneys following symphysiotomy and bilateral nephropexy.

trolled by an additional mattress suture or by direct clamp and ligature. Sometimes it is feasible and desirable to reflect the capsule of the renal isthmus in the form of a cuff and to suture it over each severed end. Further hemostasis is thus effected and constitutes a more finished technic.

When the two kidneys have been separated, bilateral nephropexy is done. (Fig. 4.) We concur with Foley that nephropexy is an important part of the operation.

In cases in which the ureter is inserted high into the renal pelvis, with definite ureteropelvic obstruction, we believe that some type of pyeloureteroplasty should be done. The nephrostomy tube, splinting catheter and Penrose drains are brought out retroperitoneally, either through a stab wound in the flank or at the lateral end of the abdominal incision.

When unilateral nephrectomy is to be performed in a horseshoe kidney, we expose the kidney to be removed. All vessels leading thereto are ligated and divided; this assists in establishing the area of the isthmus to be incised. A single row of mattress sutures is used to control bleeding from the kidney to be preserved.

Closure of the wound is accomplished in a routine manner. As mentioned previously, splinting tubes, catheters and drains are brought out retroperitoneally. The posterior peritoneum is closed with a continuous suture of catgut. The anterior abdominal wall is closed in layers. The peritoneal cavity proper is not drained.

Routine postoperative management indicated for renal surgery is followed, keeping in mind also that an abdominal opening has been made which may alter the postoperative care to some degree.

A point of interest, we believe, is that in a number of our cases infection in the urine was established, but this did not give rise to any unusual complications or aggravate the morbidity. Thus, the transabdominal approach to the diseased horseshoe kidney is no more hazardous than the retroperitoneal flank approach. The patient in whom operation for abdominal aneurysm was performed and in whom aorta homograft was accomplished was the only fatality in this series. Death was due to hemorrhage.

CASE REPORTS

CASE 1. (Hosp. No. 28847.) A sixty year old white man with diabetes was admitted to the hospital because of a persistent dull backache most severe on the right side, and a history of gross hematuria. Physical examination revealed no abnormalities. His blood pressure was 140 systolic, 85 diastolic. Laboratory studies revealed a free blood sugar of 415 mg. per 100 cc. The urine contained both red and white blood cells and many bacteria (Escherichia coli). Intravenous urography, retrograde pyelography and aortography were performed. A diagnosis of renal calculi in the right side of a horseshoe kidney was made. Right pyelolithotomy and pyeloureteroplasty were performed through a transperitoneal incision and the colon was

mobilized on the right side. The patient had an uneventful postoperative course; the splinting catheter and nephrostomy tube were removed on the thirty-first postoperative day.

CASE II. (Hosp. No. 25570.) A sixty year old white man with a known history of recurrent renal calculi was admitted to the hospital on November 20, 1951, with left renal colic, chills and fever. Physical examination disclosed tenderness in the left flank and the left upper quadrant. His blood pressure was 120 systolic, 80 diastolic. Laboratory studies revealed that the urine contained many red and white blood cells. A culture of the urine produced a heavy growth of bacteria (Pseudomonas aeruginosa). Roentgenologic studies proved the presence of a horseshoe kidney with numerous calculi in the left side of the organ. Symphysiotomy and right nephropexy were performed transperitoneally by reflecting the colon on the right side. Twenty-four days later left nephroureterectomy was accomplished through a routine flank incision. The patient's hospital course was satisfactory and without complications. He was discharged seventeen days after completion of surgery. Subsequently he passed a small calculus from the right side.

CASE III. (Hosp. No. 20192.) A twenty-three year old white railroad switchman was referred to the hospital on November 7, 1950, because of low back pain. This became more severe when he was standing. Abdominal pain occurred frequently during his work. Physical observations were not unusual; however, he experienced some discomfort when pressure was applied to the abdomen just above the umbilicus. This was frequently noted during his work when the body was used to apply pressure to a switchman's bar. His blood pressure was 130 systolic, 80 diastolic. The urinalysis indicated many white blood cells, a few red blood cells, and Gram's stain showed many gram-negative rods. Intravenous urograms revealed a horseshoe kidney, and this was confirmed by retrograde pyelograms. Structurally this anomalous kidney was not unusual. A transperitoneal approach with incision of the mesocolon permitted symphysiotomy and bilateral nephropexy. The hospital course was uneventful and the patient returned to work two months later free of symptoms.

Follow-up intravenous urograms indicate the positional change in both renal structures and ureters with good result. He has been completely relieved of the abdominal distress, but some low back pain persists. The surgical indications in this case were not clear-cut; however, the relief of pain justifies our aggressiveness.

CASE IV. (Hosp. No. 7163.) A sixty-five year old white man with a known horseshoe kidney entered the hospital on July 24, 1952, because of abdominal pain and fever. Frequent and painful urination had been experienced on occasion. Physical examination disclosed an obese man with definite tenderness in the left flank on deep percussion. His blood pressure was 218 systolic, 120 diastolic. Laboratory study of the urine revealed a marked pyuria, some red blood cells and 1 plus albumin. Culture of the urine produced a heavy growth of E. coli. Intravenous urography and retrograde pyelography indicated a horseshoe kidney with multiple calculi in the well dilated left renal pelvis. Left nephrectomy was performed transperitoneally, with mobilization of the descending colon. The postoperative period was quite satisfactory and he was discharged on the fourteenth day after operation.

His life continued comfortably for approximately sixteen months. He was seen again in December, 1954, with extreme hypertension and renal failure, and he died before the month had ended.

CASE V. (Hosp. No. 42204.) A fifty-three year old taxicab driver was admitted to the medical service of the hospital on October 26, 1953. He complained of abdominal pain of increasing severity over a period of seven years. This pain was more severe when he sat in his taxicab for long hours; the pain extended into the groin and inner aspect of the thigh, particularly on the left side. Physical examination revealed tenderness in the left flank and on the left side of the abdomen. His blood pressure was 140 systolic, 80 diastolic. Laboratory studies of the urine showed numerous white and red blood cells. Many bacteria were present; on culture and Gram's stain they proved to be Staphylococcus aureus and beta hemolytic streptococcus. Intravenous and retrograde pyelograms established the diagnosis of horseshoe kidney with a calculus in the left renal pelvis. Through a transperitoneal and transmesenteric approach, left pyelolithotomy,

FIG. 5. Pyeloureterogram showing tumor in left half of horseshoe kidney.

symphysiotomy and bilateral nephropexy were performed. Recovery was uneventful and he was discharged on the tenth day after operation. Some difficulty has been encountered in combating infection, but the patient has complete relief from pain.

CASE VI. (Hosp. No. 12902.) A forty-one year old white man with a known horseshoe kidney entered the hospital on April 21, 1954. He complained of persistent, progressive abdominal pain for a period of ten years. The pain was most evident in the left upper region of the abdomen and extended to the left lower quadrant and to the thigh at times. Physical examination revealed an easily palpable, shifting, tender mass in the left mid-portion of the abdomen. There was considerable tenderness on deep percussion over the left costovertebral angle. Laboratory findings were normal. Urinalysis revealed a few red blood cells on microscopic study but little evidence of infection. Urine cultures were sterile. Intravenous urography and retrograde pyelography confirmed the diagnosis of horseshoe kidney. The right pelvis and ureter were considered normal for this type of kidney. The left pelvis had a marked extra-

FIG. 6. Translumber aortogram showing puddling of dye in tumor area.

renal type of hydronephrosis with obstruction at the ureteropelvic junction. Surgery was undertaken and again a transperitoneal, transmesenteric approach was employed. Left pyeloplasty, with resection of a portion of the renal pelvis, and Davis type ureteroplasty were performed. Symphysiotomy and bilateral nephropexy were also accomplished. A polyethylene ureteral splint and nephrostomy tube were left in place. The postoperative period was uncomplicated. The ureteral splint was removed on the twenty-fourth day and the nephrostomy tube on the twenty-sixth day. A good functional result was obtained; however, infection was now present in the left urinary tract. Two months after surgery the patient was symptomatically well but some pyuria persisted.

CASE VII. (Hosp. No. 45668.) A fifty-three year old white man was admitted to the hospital on April 14, 1954. For the preceding two months he had complained of urgency and frequency of urination. He had noted blood in the urine on numerous occasions. A dull ache with some severe pain was constantly present in the area of the left flank. He had lost about 10 pounds over a period of three months. Physical examination disclosed a rather large mass in the left upper quadrant; this was moderately tender and quite firm in consistency. The urine was grossly bloody. X-rays of the chest and a complete bone survey revealed no abnormalities. Intravenous urography and retrograde pyelography demonstrated a horseshoe kidney with a neoplasm

FIG. 7. Surgical specimen.

FIG. 8. Surgical specimen opened.

in the left half of the structure. (Fig. 5.) Translumbar aortography revealed the usual multiple vascular distribution of vessels in horseshoe kidney with definite pooling of the dye in the left renal mass consistent with the presence of neoplasm. (Fig. 6.) Surgery was undertaken and through a transperitoneal, transmesocolic approach, left ureteronephrectomy was accomplished. Aided by the aortogram, the vascular supply to the tumor was easily identified and ligated. Symphysiotomy was performed and the tumor mass occupying the left half of the horseshoe kidney was easily removed. The neoplasm proved to be adenocarcinoma of the kidney. (Figs. 7 and 8.) The postoperative period presented no complications. On the fifteenth day of convalescence x-ray therapy was started since tumor tissue had been found to extend into one of the large renal veins of the pedicle. This patient is moderately well to date, without demonstrable evidence of his former disease.

CASE VIII. (Hosp. No. 61634.) A fifty-eight year old white housewife was admitted to the hospital on December 23, 1952. She had complained during the previous fourteen months of pain in the left flank and abdomen. This distress was aggravated by activity and was quite disturbing even during her routine household duties. She had had several episodes of frequency and this had been diagnosed as "bladder infection." Physical examination disclosed moderate tenderness in the left costovertebral and left upper abdominal regions. Deep percussion intensified the pain considerably. The left kidney was not palpable, however. Laboratory studies revealed infection in the urine from the left renal pelvis and bladder. E. coli were cultured from the urine. Intravenous urography and retrograde pyelograms established the diagnosis of horseshoe kidney with a moderate pyelectasis on the left and obstruction at the ureteropelvic outlet. Translumbar aortography demonstrated the vascular supply to the horseshoe kidney with extreme clarity. One of these vessels appeared to be the possible cause of the ureteropelvic obstruction. A transperitoneal, transmesocolic approach was again employed. Following the vascular pattern as outlined by the aortogram, a vessel passing across the ureteropelvic junction was divided and lysis of the ureter at this point was accomplished. Symphysiotomy and left nephropexy were performed. The patient's hospital course was not unusual; the urinary tract infection was corrected and a good functional result, with relief of symptoms, was obtained. Two months following surgery she had a mild recurrence of infection which was easily controlled.

CASE IX. (Hosp. No. 45936.) A sixty year old white man was admitted to the general

surgical service on March 24, 1954. He stated that he had noted a "painful mass" in the mid-abdomen for the previous four years. Recently this mass had increased somewhat in size and, due to his loss in weight, had become more noticeable and more painful when pressure or contact was made over the abdomen in this area. Physical examination disclosed a large pulsating mass in the right mid-portion of the abdomen. This was moderately tender and occupied the area of the abdominal aorta. A clinical diagnosis of abdominal aneurysm was made. Laboratory studies were not unusual. The urine, except for the presence of red blood cells, was normal. Intravenous urography showed a marked displacement of the left kidney anteriorly and to the midline. The renal pelvis was somewhat distorted due to change in position, but normal excretion of dye appeared from both kidneys. Translumbar aortography demonstrated a large aneurysm of the aorta with much calcification, but other vascular patterns were lacking. Resection of the aneurysm was accomplished, and a homograft re-established continuity of the aorta. During this procedure a horseshoe kidney was encountered and it was necessary to displace this structure considerably to facilitate removal of the aneurysm. Several vessels in the area of the isthmus were divided and the kidney was then returned to its normal position. The presence of the horseshoe kidney added considerable difficulty to this already hazardous surgical procedure. The postoperative period was stormy, and despite numerous blood transfusions the patient died the day after surgery.

SUMMARY

The occurrence of horseshoe kidney has been widely realized for hundreds of years, but only within the past four decades has any appreciable progress been made in its surgical management.

Because of the frequent presence of anomalous renal vessels and the difficulty in choosing a site for division of the isthmus, aortography can be a valuable part of the preoperative study of the patient with a horseshoe kidney.

The surgical approach we have employed has been transabdominal and transperitoneal. In our earlier cases the colon was mobilized mesially; later, a transmesenteric approach through an avascular area was employed. Symphysiotomy is performed between parallel rows of mattress sutures. Any other necessary corrective surgery is then performed and is followed by bilateral nephropexy. Nephrostomy tubes, splinting catheters and drains are brought out retroperitoneally.

Eight cases are presented in which the horseshoe kidney was either symptomatic or diseased and in which surgical intervention was indicated. The pathologic conditions encountered in these patients were: unilateral calculi, four cases; hydronephrosis, two; carcinoma, one; pain, one. Surgical procedures undertaken consisted of: pyelolithotomy, two cases; pyeloureteroplasty, two; symphysiotomy, seven; unilateral nephropexy, two; bilateral nephropexy, three; nephroureterectomy, three. Another case in which horseshoe kidney presented a complicating factor in the course of surgery for abdominal aneurysm is also reported; the kidney was not subjected to surgery.

CONCLUSIONS

The symptomatic or diseased horseshoe kidney is deserving of surgical correction.

Aortography is a valuable adjunct in the preoperative evaluation, surgical planning and surgical reconstruction of the diseased horseshoe kidney.

The transperitoneal approach, with either mobilization of the colon or direct approach through the mesentery, is the preferred route. This approach is convenient, time-saving and lends itself to better visualization of anatomic structures within the operative field. It permits exposure of the entire horseshoe kidney and bilateral corrective procedures can be performed.

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Potassium Levels Following Anorectal Surgery

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INASMUCH as the frequent persistence of fatigue, drowsiness and languor for a two- to three-week period following anorectal surgery suggested the presence of lowered potassium levels in certain patients, this study was undertaken to determine the following factors: (1) whether significant changes occur in potassium levels after such surgery, and (2) the effects, if any, of supplying potassium chloride (4 gm. daily) postoperatively, in addition to a potassium-adequate diet.

NORMAL POTASSIUM VALUES

Potassium is largely intracellular, the concentration in the extracellular fluid being only 5 per cent of that within the cells.[1] Although they provide only a rough approximation of potassium balance within the tissues, serum potassium values are widely used as measures of potassium because they are readily obtainable. Normal serum potassium levels in the adult vary between 16 and 22 mg./100 cc., balance being maintained on a daily intake of about 3 to 4 gm.[2] An adult can ingest as much as 6 gm. per day with safety, provided he is free from renal damage or adrenal insufficiency.[3]

POTASSIUM DEFICIENCY: SYMPTOMS AND CAUSES

Early symptoms and signs of low body potassium are primarily those of decreased muscular irritability and weakness, lethargy and disturbances of conduction and contractility of the heart muscle.[4,5] If untreated, these symptoms may progress to more serious conditions, such as loss of peripheral reflexes, paralysis, dilatation of the heart muscle, and death from respiratory failure.[6]

Primary dietary deficiency of potassium has not been reported, but depletions secondary to pathologic conditions are often encountered by the clinician. Deficiency results whenever potassium output exceeds intake; when potassium-rich body fluids are lost through vomiting, diarrhea, intubations or fistulas, for example; when potassium output is increased through the administration of ACTH or a carbonic anhydrase inhibitor (diamox®);[7] or if potassium stores are diluted through the prolonged intravenous administration of potassium-free solutions. Alterations in potassium levels following abdominal and thoracic surgery have received considerable attention in recent years,[8,9] potassium loss being attributed to tissue breakdown, blood loss, increased hormonal activity and inadequate food intake.

STUDY

Although I have made pre- and postoperative serum potassium determinations in approximately fifty patients, for the sake of brevity findings in only sixteen unselected cases will be reported in detail in this paper. Findings in other patients not included herein were similar.

All sixteen patients were in fairly good health: each had undergone a routine physical examination and a complete urinalysis; red, white and differential blood counts and bleeding and clotting time determinations had been made preoperatively. The ages of the patients in the group ranged from twenty-six to sixty-one years. Anorectal conditions corrected include hemorrhoids, anal fissures and anal fistulas. In each instance, either caudal or low spinal anesthesia was employed.

Method. Serum potassium values* were obtained for each patient on the day preceding

* Minor variations in serum determinations may have occurred, as determinations were made independently by technicians in several hospitals.

surgery and on the second postoperative day. The second postoperative day was chosen for the final determination because few patients undergoing rectal surgery voluntarily resume a normal, general diet before that day and, presumably, potassium stores should be at their lowest at this time if depleted by anorectal surgery and two days of poor dietary replacement. Reasons for refusal of food prior to this time include lack of appetite, nausea from pre- or postoperative sedation, and in a few instances headaches. Patients who were unable to resume their ordinary diet by the second postoperative day are not included in this study.

TABLE 1
MEASURES OF SERUM POTASSIUM; CHANGES FOLLOWING ANORECTAL SURGERY

Patient No.	Serum Potassium Values (mg./100 cc.)		
	Preoperative	Second Postoperative Day	Change†
1	18.9	20.8	1.9
2	20.5	19.8	−0.7
3	20.8	19.4*	−1.4
4	18.6	17.4	−1.2
5	21.3	21.3	0.0
6	15.5	13.9	−1.6
7	14.3	16.5	2.2
8	20.0	19.0	−1.0
9	19.9	18.1	−1.8
10	17.0	18.0	1.0
11	21.3	20.8	−0.5
12	19.4	17.5	−1.9
13	17.0	16.0	−1.0
14	19.0	17.0	−2.0
15	16.5	16.5	0.0
16	17.5	16.5	−1.0

* Taken on the third postoperative day.
† Average change, −0.56.

Patients were discharged from the hospital on either the third or fourth postoperative day, after which they were seen twice weekly in the office. Patients who complained of weakness and lethargy into the second postoperative week, despite supplement of their ordinary diets by two 6 ounce glasses of orange juice per day, were given 4 gm. of potassium chloride daily during the following week.

Results. No constant trend was observed. Serum potassium values dropped postoperatively in eleven patients, remained unchanged in two, and rose in three. The average for the group was a drop of only 0.56 mg./100 cc. The greatest rise was 2.2 mg (patient 7); the greatest drop was 2.0 mg. (patient 14). (Table 1.)

No consistent improvement attributable to the daily administration of potassium chloride occurred. Each of the sixteen patients in this study received potassium chloride during the second postoperative week. Three reported subjective improvement after receiving the potassium chloride supplement for two days: patient 10, whose serum potassium value had risen 1 mg.; patient 5, whose serum potassium value remained unchanged; and patient 14, whose serum potassium level had fallen 2 mg. postoperatively.

COMMENTS

Similarity of complaints of patients following anorectal surgery to symptoms of negative potassium balance following abdominal surgery suggested the possibility that potassium loss might be a factor in the frequent persistence of weakness and languor for periods of two or three weeks following anorectal surgery, as patients were free from debilitating conditions which might account for their complaints.

No constant trend was demonstrated, nor could changes be explained on the grounds of potassium loss. Had serum values for patients with abnormally low levels of serum potassium prior to operation consistently risen after surgery, this might have indicated a leakage of potassium from cells into the serum. However, this was not the case, nor did all patients with serum potassium values within normal range preoperatively demonstrate a drop in serum potassium.

Potassium was administered for a period during the second postoperative week to rule out the possibility that symptoms of fatigue reported by the patients might be the expression of a subclinical deficiency not reflected in serum potassium values. (Serum potassium values were not obtained during the second postoperative week.) Although three patients reported subjective improvement after two days of the potassium supplement, a like number might have been expected to improve spontaneously during this period. So far as could be determined, the supplementary potassium had no consistent or appreciable effect.

CONCLUSIONS

Lowered potassium levels apparently are not responsible for fatigue, drowsiness and languor reported by patients who have recently undergone anorectal surgery. Potassium supplements in the second postoperative week have no consistent or appreciable effect on the patients' condition.

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Benign Tumors of the Ureter

WITH REPORT OF A CASE

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PRIMARY tumors of the ureter were considered rare until two decades ago. Rayer [43] recorded the first case in 1840. By the year 1900 only eight others had been listed by Foord and Ferrier. All these tumors had been found at autopsy.

The first presurgical diagnosis of benign tumor of the ureter was made by Albarran [1] in 1902. This tumor was found on cystoscopy. In 1931 Renner [44] described only three cases in 13,000 autopsies performed at the Pathological Institute of Vienna. In 1953 Senger and Furey [50] collected 310 cases from the literature. This group comprised benign and malignant tumors. A review of this series by Mortensen and Murphy [38] in 1950 revealed seventy-seven benign cases, including two of their own.

The present article pertains primarily to the category of benign ureteral tumors.

OBSERVATIONS

Classification. Tumors of the ureter fall into the following two groups: (1) Papillary neoplasms: These are the most frequent, approximately 64.6 per cent (Senger and Furey). Of this group 42.4 per cent are papillary carcinomas, 15 per cent transitional cell carcinomas, 6.8 per cent squamous cell carcinomas and 19.7 per cent benign papillomas. However, according to Swift-Joly [51], of 133 ureteral tumors, 131 were papillary. (2) Nonpapillary tumors (35.4 per cent): Those arising from the wall of the ureter extraneous to the mucosa are angiomas, myomas, fibrolipomas, neurofibromas and malignant squamous and epidermoid carcinomas.

Age and Incidence. According to Senger and Furey, 80.7 per cent of all ureteral tumors occur in patients in the fifth, sixth and seventh decades, with 41 per cent appearing in the sixth decade. Approximately 79 per cent of the tumors are papillary carcinomas and are discovered in the fifth and sixth decades of life. The majority of benign papillomas have been found in patients in the fifth and sixth decades.

Sex. Ureteral tumors are more common in men than in women (65:35 per cent), according to Senger and Furey.

Site. Vest [54] reported that the most prevalent site of these tumors is the lower third of the ureter (60 per cent). In 30 to 35 per cent of patients the tumor was found protruding from the ureteral orifice.

Pathology. Tumors of the ureter have been considered histologically similar to those found in the renal pelvis and bladder. (Malignant tumors involving the ureter are, however, much more resistant to treatment than are those seen in the renal pelvis and bladder.) The difficulty in treating malignant ureteral tumors is partly attributable to the tenuity of the ureteral wall and its profuse vascular and lymphatic supply, resulting in early metastases.

Most benign ureteral neoplasms appear to be solitary. They are termed simple papillomas, villous tumors and even granulomas. Vest classifies the benign epithelial tumors as: (1) Polyps, i.e., tumors revealing stroma proliferation with little alteration in the epithelial cells. These are usually pedunculated and have been named fibromyomas, fibromas or fibrous polyps (Hunner [25], Moore [36], Argue [2], Johnson and Smith [29]). (2) The most common varieties of epithelial tumors are papillomatous which, in 85 per cent of the reported cases, were discovered in the lower part of the ureter. They are usually villous or sessile and are rarely pedunculated. The tumors may be multiple and occasionally occupy the entire length of ureter.

Histologically, a papilloma may be considered a tumor composed of transitional epithelial cells arranged in several layers over a stalk, which consists of vascular stroma. Some adenomatous tumors have been described and designated "adenomatous papillomas" by Albarran, Chauvin and Romieu, Horesco and Ramsey.

A question which frequently arises in discussions relating to papillary tumors in general is: "Can we be positive that a given tumor is benign or malignant"? There have been reports of histologically benign tumors which metastasized. According to Vest [*54*], a benign papilloma has the following characteristics: (1) It is a tumor composed of cells which are uniform and similar to those lining the normal ureteral mucosa. (2) It presents few or no mitotic figures or multinucleated cells. (3) The basement membrane shows no evidence of invasion, and (4) There is no fusion of papillae.

Although histologically benign papillomas rarely metastasize they may, admittedly, produce implants. While implants, as a rule, pass from the renal pelvis and ureter to the bladder owing to normal ureteral peristalsis and normal downward flow of urine, it is known that in examples of reversed peristalsis, implantation may occur retrogressively (Jona [*30*]). In 1934 Willis [*57*] reviewed a report by Boger in which the patient had a rectal adenocarcinoma involving the lower portion of the ureter. Metastases occurred in the renal pelvis by implantation. Other disseminations had been carefully ruled out.

According to Hinman [*23*], if small papillary growths are found in the renal pelvis in a patient with a large ureteral tumor, the primary growth must be sought in the renal pelvis. This view is strongly opposed by Mortensen and Murphy [*38*] who believe that this is an example of retrograde implantation. Dean [*12b*] reported that he observed a histologically proved benign papilloma which metastasized despite the fact that on histologic examination the metastasis was proved to be benign.

Doss [*13*] collected from the records of the Mayo Clinic 392 examples of grade 1 tumors of the bladder. He did not find one report of metastasis; yet in the same clinic Cook and Counseller [*11*] concluded that what is commonly designated "benign papilloma" is neither clinically nor pathologically benign. It is Vest's view that the opinion of Cook and Counseller was erroneous in that implants were studied rather than metastases.

In 1941 Hundley and Hunter [*24*] reported a ureteral tumor which was diagnosed as histologically benign but seven months later proved to be recurrent.

Another debatable question frequently arising is whether or not it is possible for a benign ureteral papilloma to recur locally as a new tumor or as an implant and subsequently change into a malignant papilloma. Such examples have been reported by Vorpaul [*55*], Roux [*46*] and Battle [*6*]; however, a careful review of these cases fails to substantiate these authors' reports.

Sixty-three recurrent vesical tumors from the records of the Mayo Clinic were carefully reviewed and fifteen were found to be papillomas classified as grade 1 without increase in malignant propensities (Frater, Crenshaw).

BENIGN PRIMARY URETERAL TUMORS

Incidence. Twenty-nine benign tumors of the ureter were collected from the literature by Melicow and Findlay [*35*] in 1932. Six years later ten additional cases were reported by Rusche and Bacon [*47*], with the addition of one of their own, bringing the total to forty.

In 1942 Johnson and Smith [*29*] collected nine more reports, including one of their own, making a total of forty-nine. From 1942 to 1950, twenty-seven more examples were collected by Mortensen and Murphy [*38*], with the addition of three of their own.

Our recent review of the literature from 1950 to 1955 revealed an additional fifty-one examples, of which thirty-eight were unilateral single tumors; six, unilateral multiple tumors; two, bilateral multiple tumors; and two were listed as probable tumors. In summary, it appears that 127 cases were reported to which we add one of our own.

Symptoms. The main symptoms of ureteral tumor are hematuria, pain and a sense of a mass in the loin caused by a hydronephrotic kidney. According to Senger and Furey [*50*], hematuria was present in 70 per cent, pain in over 50 per cent and a palpable mass in 20 per cent of patients. Other signs and symptoms were the passage of slender blood clots, chills and fever, increased urinary frequency and weight loss. Most of these symptoms resulted from superimposed renal infection.

Diagnosis. A review of the recorded cases made by Senger and Furey showed the average lapse of time before diagnosis was 25.1 months for right-sided lesions and 16.2 months for left-sided ones.

The discovery of a tumor at the site of the ureteral orifice, especially one that protrudes during ureteral peristalsis, is, of course, diagnostic (16 per cent, Senger and Furey). In the majority of patients the ureteral catheter encounters an obstruction (complete, 56 per cent; incomplete, 3 per cent) at the site of the tumor. As a rule the obstruction is impassable. Catheter manipulation at the site of the growth frequently induces bleeding through the catheter. If it is possible to advance the catheter beyond the obstruction, the urine obtained from the renal pelvis will be free of blood.

Intravenous pyelography cannot be relied upon to aid greatly in outlining the ureter. Retrograde ureterography is required to accomplish this. A spiral catheter is used with a bulbous tip to occlude the ureteric orifice. The salient features of a positive ureterogram are: (1) ureteric dilatation below and above the site of obstruction, (2) defect in ureterogram at the tumor site, and (3) evidence, at times, of hydronephrosis (Vest, 15 per cent).

Differential Diagnosis. The greatest difficulty in these cases is to differentiate a non-opaque calculus from a ureteral tumor. A waxed-tip catheter may be of some aid in detecting a calculus. Indicative of the complexities encountered in these patients is the infrequency in the clinical records of final diagnosis made prior to surgical exploration. According to Scott [49] a diagnosis was made in only 36 per cent of the recorded cases. In the series reported by Melicow and Findlay [35] the percentage was the same. We believe that with modern facilities and technics diagnostic errors can be greatly reduced if the possibility of ureteral tumor is kept in mind whenever a vesical lesion is present. This is especially true if the lesion occurs in the area of a ureteral orifice, or if an unexplained, persistent obstruction is found during cystoscopy and careful ureterographic examination of the ureteral path, with reduced function and ectasia of the kidney pelvis. It is evident, of course, that the true nature of a tumor cannot be ascertained by means other than histologic examination.

Treatment. Some of the conservative measures are nephrectomy and subtotal ureterectomy, fulguration, radium, subtotal ureteral resection with reanastomosis or reimplantation into the bladder, and local removal of the tumor with a part of the surrounding ureteral wall (Vest).

The treatment of choice is complete nephroureterectomy. This procedure is best because of the diagnostic difficulty concerning the histologic character of the tumor and the hazard of dissemination in taking a biopsy specimen during the course of the operation. The advisability of performing a one- or two-stage operation depends upon the following factors: the patient's physical condition; presence or absence of severe degree of infection of the renal pelvis, kidney or ureter; and presence of dissemination. According to Foord and Ferrier [18] a one-stage nephroureterectomy carries a mortality of 40 per cent, while in a two-stage operation the mortality was only 5 per cent. We believe that present surgical technics, blood replacement, use of antibiotics and electrolyte adjustments, should make the one-stage procedure feasible and safe. When the tumor involves the lowermost part of the ureter, we believe it advisable to remove a cuff of vesical wall around the ureteral orifice in extirpation of the tumor itself.

Prognosis. While the prognosis in regard to cure in malignant tumors of the ureter is far from satisfactory, it is good in patients with histologically proved benign tumors which have been radically removed.

CASE REPORT

M. P., a sixty-one year old white man, was first seen on October 1, 1954, complaining of turbid urine and terminal dribbling. No dysuria, backache or change in urinary frequency had been noted.

Family history was non-contributory. The patient had undergone bilateral inguinal herniorrhaphy in 1945, and in 1949 a pedunculated polyp was removed from the rectum. Since 1949 he had been treated for chronic prostatitis.

A No. 21 Brown-Buerger cystoscope was introduced with slight difficulty because of obstruction at the neck of the bladder. The bladder was moderately trabeculated. Prominent collar contracture was present at the vesical neck. The posterior urethra and verumontanum showed congestion and edema. A well defined median bar was noted. Both kid-

FIG. 1. Retrograde pyelogram showing absence of dye in renal pelvis. Note bulbous character of dye as it impinges on acorn-shaped shadow opposite third transverse process.

FIG. 2. Intravenous pyelogram showing normal left pelvis and hydronephrotic right pelvis.

neys were readily catheterized and urine from the right kidney showed some red blood cells and a few white blood cells, while urine from the left kidney showed a few red blood cells. Phenolsulfonphthalein given intravenously returned in good color from the left kidney in seven minutes and in poor color from the right kidney in thirteen minutes.

Bilateral shadowgraphy disclosed no abnormality. A chest film was essentially negative. Intravenous pyelography showed good filling of an intrarenal left kidney pelvis in ten minutes. The lower end of the left ureter was slightly dilated. Only a trace of dye was present in the right pelvis but the calices were moderately dilated. Subsequent excretory urography again showed poor visualization of the right pelvis.

A retrograde pyelogram revealed no dye in the pelvis of the right kidney, but there was a bulbous enlargement of the upper end of the ureter directly below the ureteropelvic juncture, with a defect suggestive of a neoplasm. Profuse bleeding from the ureter followed this procedure.

A second retrograde pyelogram revealed the right ureter to be filled with dye up to an area opposite the transverse process of the third lumbar vertebra, where it abruptly stopped. Here the ureter widened into a bulbous end which was flat. Above this area an acorn-shaped shadow of less density was discernible. No dye entered the renal pelvis. (Fig. 1.)

A subsequent intravenous pyelography showed dilated calices with incomplete filling of the right pelvis which was hydronephrotic. The seventy-five-minute film revealed retention of dye in both pelves. (Fig. 2.)

Physical examination revealed the following: blood pressure, 140/90; moderate right costovertebral tenderness; liver edge palpable three fingerbreadths below the right costal margin; right seminal vesical palpable on digital rectal examination.

Laboratory reports were as follows: hemoglobin, 94.2 per cent; white blood cell and differential count, normal. Sedimentation rate 24 mm./hour (Westergren). Blood chemistry: urea nitrogen, 20.8 mg. per cent; uric acid, 3.65 mg. per cent; sugar, 113 mg. per cent; urea clearance, 74 per cent; acid phosphatase, 3.4 Bodansky units. Cultures: bladder urine

FIG. 3. Opened ureter showing character and position of tumor.

showed growth of Staphylococcus aureus and Proteus morgagnii. Specimens from both kidneys were sterile.

Presurgical diagnosis was solitary tumor of the ureter with infected hydronephrosis.

At operation on November 12, 1954, the right kidney and ureter were approached through an incision in the right loin. A soft rubbery mass, about the size and contour of a lima bean, was found in the upper ureter approximately 1½ inches distal to the ureteropelvic juncture. The mass originated from the mucosa of the right ureteral wall. The renal pelvis was greatly dilated but the ureter below the lesion appeared normal. Upon opening the ureter, a tumor about the size of a lima bean was seen, of a waxy yellow color, attached to the ureteral wall by a broad pedicle. The surface of the tumor appeared smooth. (Fig. 3.) A right nephroureterectomy was performed.

The pathologist's report was as follows: "Kidney and ureter specimen, 24 cm. in length. At a distance of 13 cm. from the distal end of the ureter a fusiform enlargement was seen. On section the lumen was dilated and filled with a polypoid tumor measuring 3 cm. in length and 1 cm. in thickness. It was found to be attached to the wall of the ureter by a short pedicle measuring 2 cm. in circumference. The kidney pelvis was dilated to the size of a hen's egg. The calices were moderately dilated and a considerable amount of renal parenchyma was still present. The ureter for a distance of 6 cm. below the polyp was moderately dilated. The distal 7 cm. were not dilated. No evidence of infiltration into the ureteral wall was found.

"Microscopically the specimen showed a benign polypoid papilloma of the ureter, transitional cell variety. The kidney specimen was found to contain foci of renal atrophy and focal cystic changes within the renal pelvic mucosa and achronic pyelonephritis." (Figs. 4 and 5.)

The postsurgical course was complicated by a temporary incomplete shutdown of the remaining kidney with resulting electrolyte imbalance. However, with supportive measures and electrolyte adjustment the patient's condition improved and he was discharged from the hospital December 4, 1954. He was seen several months later and found to be well.

SUMMARY

Benign tumors of the ureter are much less frequent than malignant ones. They involve the lower third of the ureter, as a rule. In most patients the tumors are solitary, of the papillomatous variety and sessile rather than pedunculated. Benign papillary ureteral tumors on rare occasions have been known to metastasize, yet they may produce implants.

The main signs and symptoms of benign ureteral tumor are hematuria, pain in the loin and appearance of a mass in the loin owing to a hydronephrotic kidney. Superimposed renal infections are not unusual.

A characteristic of this type of lesion is the

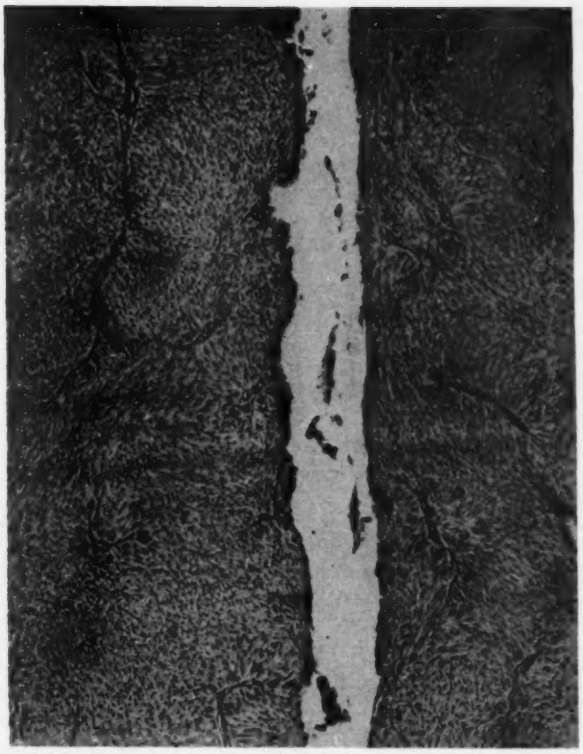

FIG. 4. Low power photomicrograph showing edge of base of polypoid papilloma with solid character of tumor and absence of infiltration of ureteral wall. Original magnification × 80.

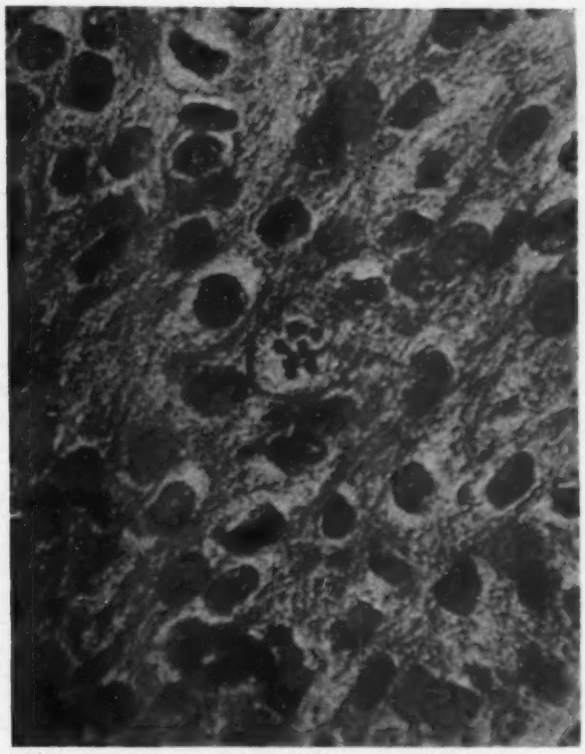

FIG. 5. High power photomicrograph of polypoid papilloma showing regularity of transitional type cells and of nuclei. A mitotic figure can be seen. Original magnification × 800.

discovery of an obstruction in the ureter which bleeds during manipulation of the catheter and which fails to show a shadow on the plain roentgen film or a scratch mark on the paraffin bulb. If one is able to surmount the obstruction and pass the catheter into the renal pelvis, the urine obtained there reveals no blood. Excretory pyelography is of little value in diagnosis. It is only through the careful interpretation of a good retrograde ureterogram that one can visualize the lesion. A positive ureterogram will disclose: (1) dilatation of the ureter below and above the site of obstruction; (2) a defect in the ureterogram at the site of the tumor, and (3) evidence of hydronephrosis. The discovery of a vesical tumor, particularly in the immediate area of a ureteric orifice, is suggestive of a tumor in the ureter or renal pelvis. The exact nature of the tumor, of course, cannot be established without histologic examination. Biopsies of ureteral tumors are not recommended.

The treatment of choice in any type of ureteral tumor, if possible, is complete nephroureterectomy. If the tumor is in the lowermost portion of the ureter, a cuff of bladder should be included in the resection.

A survey of the literature up to the middle of 1955 revealed a total of 128 cases of benign tumors of the ureters, including the one herein reported.

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Massive Hemorrhage Due to Aberrant Pancreatic Tissue in the Cardia of the Stomach

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The presence of aberrant pancreatic tissue in the gastrointestinal tract is not rare. It was described in 1859 and some authors state that it was first mentioned as far back as 1727. Approximately 900 cases have been reported, most of them within the past fifteen years. This condition is detected frequently today because of better laboratory procedures and because of the increased amount of surgery being performed on the gastrointestinal tract.

The condition is rarely diagnosed preoperatively because the more common conditions of ulcer and cancer are usually considered by the examiner. The incidence in a group of over 4,000 autopsies was approximately 1.9 per cent. Barbosa et al. [1] stated that in a series of surgical cases it was encountered in approximately one of every 500 operations on the gastrointestinal tract.

The origin of aberrant pancreatic tissue in the gastrointestinal tract is congenital. The tissue probably becomes detached from the primary anlage and is transplanted during development to the longitudinal growing gut and becomes involved with the muscle coats of the wall just beneath the mucosa. As a result, pancreatic tissue can be encountered anywhere in the gastrointestinal tract. However, because of the location of the anlage the more common site is naturally in the duodenum where it occurs approximately 80 per cent of the time, in the stomach approximately 10 per cent of the time, and in the jejunum and ileum approximately 9 per cent of the time; in 1 per cent it may be found in either Meckel's diverticulum, the spleen, gallbladder or liver. The case presented herein involves the presence of aberrant pancreatic tissue in the cardia of the stomach.

The symptoms are variable and naturally depend on the location of the aberrant tissue. If the tissue is in the duodenum, symptoms of ulcer may be present; if the tissue is in the cardia, there may be no symptoms because this is the so-called "silent area" of the stomach. Symptoms also depend on the pathologic condition within the aberrant tissue, the most common being inflammation, fat necrosis, ulceration, hemorrhage and carcinoma.

The diagnosis is seldom made preoperatively unless this condition is kept in mind when patients are seen who have an atypical history of ulcer or who have had several attacks of hemorrhage from the stomach followed with asymptomatic intervals. If the aberrant tissue is in the duodenum, x-ray examination may show a defect, usually in the second portion. If the aberrant tissue is in the cardia of the stomach, x-ray examination will most likely be negative. If the aberrant tissue is polypous, x-ray examination may reveal a mass which resembles gastric polyps. Gastroscopy may be more accurate than the x-ray in the diagnosis. It may reveal a submucosal tumor which has a benign appearance. The usual diagnosis is either ulcer or cancer, and only after surgery is the diagnosis made. It is important to keep this condition in mind at the time of surgery, for if it is mistaken for carcinoma the patient will be subjected to a radical procedure which may jeopardize his chances for survival when under the circumstances only segmental resection is curative.

The gross pathologic examination shows a mass, usually lobulated. The mass may be in the wall of the stomach or may project as a polyp, or may be in the muscularis, the submucosa or the mucosa which may be ulcerated.

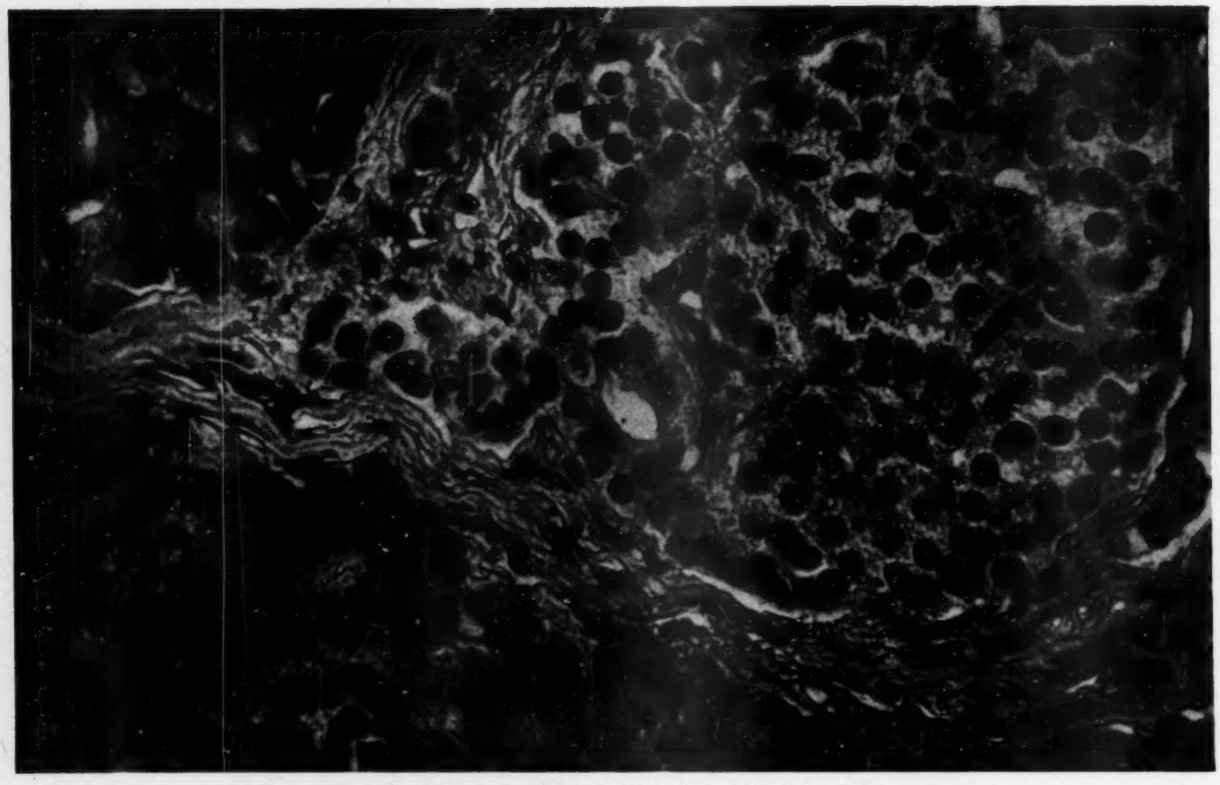

FIG. 1. Localized pancreatic acini found in section of gastric mucosa.

The mass has a soft, spongy consistency with soft edges.

CASE REPORT

J. G., a forty-nine year old man, was admitted to the hospital on November 19, 1953, because of massive gastric hemorrhage. The past history revealed that he had been deferred by the U. S. Army in 1939 because of a peptic ulcer diagnosed during the induction examination. From 1939 to two years before the present admission he had been symptom-free and had had no complaints. He was a cook, and ate and drank without experiencing any distress. Two years before this admission he had his first gastric hemorrhage which was accompanied with tarry stools and active bloody vomitus. During the subsequent two years he had five such attacks. He stated that between bleeding episodes he had no symptoms whatsoever and that for the most part he ate and drank as he pleased. All previous admissions to the hospital were because of sudden acute hemorrhage.

Examination shows an obese, pale and apprehensive male in acute distress because of recent tarry stools and vomiting of blood. He was in mild shock; his blood pressure was 95/70 and his pulse 160, thready, weak and irregular. There was no edema of the extremities or abdomen and there were no masses or tenderness in the abdomen. The liver was not palpable and no nevi were present. Aside from acute bleeding and the attending mild shock, there were no positive findings.

The diagnosis was massive gastric hemorrhage from either esophageal varices or more likely from a gastric ulcer, probably in the cardia, since ulcers in this area bleed frequently, are usually asymptomatic and as a rule are not visualized by x-ray.

Conservative management was tried at first, and the patient seemed to be sufficiently stabilized to try a barium swallow in an attempt to localize the cause of the bleeding. No varices were demonstrated in either the Valsalva maneuver or the reverse Trendelenburg position. The rugal folds of the stomach were exaggerated. There was nothing in the film that suggested ulcer or cancer of the stomach. The duodenal bulb filled quickly and emptied readily. The stomach was empty in three hours.

The impression was that there might be an

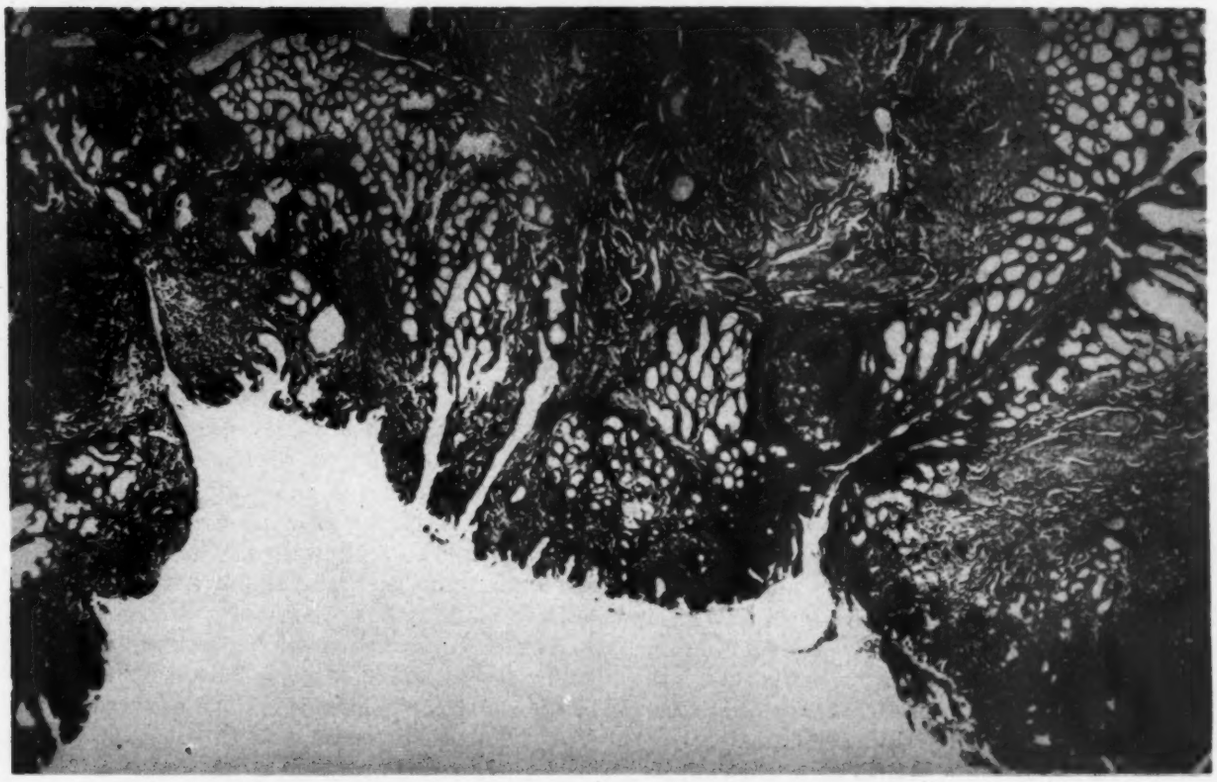

FIG. 2. Ulcerated mucous membrane of pancreatic tissue from which hemorrhage occurred.

ulcer of the gastric cardia and that the recent hemorrhage could have obliterated the ulcer crater by a clot.

The patient began to bleed again and exploratory surgery was performed. Briefly, the only finding was an indurated area on the lesser curvature rather high on the cardia. This area appeared soft and spongy. No glands were involved. The duodenum showed no scarring or other evidence of ulcer, past or present. An incision was made into the stomach and the lesion appeared to be a shallow ulceration covered with blood. It was soft and spongy with soft edges and no undermining. The pathologist, who was called at the time of surgery, believed that the lesion resembled carcinoma. However, because it was not indurated and was so spongy with absence of glands, it appeared benign and a high gastric resection with anterior gastrojejunostomy was performed. The patient responded well postoperatively and was discharged on the tenth postoperative day.

Pathologic report revealed the following: there was an induration of mucosal surface of the lesser curvature of the stomach. There was an elongated, tan ulcer measuring 3 by 1.3 cm. which was parallel to the long axis of the stomach. A microscopic picture showed large islands of pancreatic parenchyma within the wall of the stomach. Superficially most of the lesion consisted of pancreatic acini. (Fig. 1.) Deep in the stomach wall were numerous cystically dilated ducts which were mostly located in the muscularis. The gastric mucosa showed atrophy, chronic inflammation and metaplasia, with ulceration of the surface and signs of hemorrhage. (Fig. 2.) There was no evidence of malignancy. The diagnosis was aberrant pancreas in the cardia of the stomach.

CONCLUSIONS

Aberrant pancreatic tissue, although most common in the duodenum, does occasionally occur in the cardia of the stomach. When it occurs in this location, it must be differentiated from cancer. In the case reported herein the fact that the lesion was in the cardia made the condition difficult to diagnose because these lesions are usually asymptomatic and do not visualize on x-ray examination. The first indication of the presence of this lesion may be acute and sudden gastric hemorrhage.

Inasmuch as aberrant pancreatic tissue in the stomach is not too rare, it should be kept

in mind in order to avoid performing extensive, radical surgery, since simple resection will produce a cure.

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We recommend:

A Manual of Anaesthetic Techniques. By William J. Pryor, M.B., CH.B., F.F.A.R.C.S. Foreword by J. H. T. Challis, M.R.C.S., F.F.A.R.C.S. 224 pages, illustrated, with references. Baltimore, 1956. Williams & Wilkins Co. *Price* $7.00.

Breast Cancer and Its Diagnosis and Treatment. By Edward F. Lewison, B.S., M.D., F.A.C.S., Assistant Professor of Surgery, Johns Hopkins University School of Medicine, and Surgeon, Out-Patient Department, Breast Clinic, Division of Tumor Clinic, Johns Hopkins Hospital, Baltimore, Maryland. Eight contributors. 478 pages, profusely illustrated (some in color), with bibliography at chapter endings and an index. Baltimore, 1955. Williams & Wilkins Co. *Price* $15.00. (Covers the "total" care of this disease.)

Clinical Studies on Anticancer Agents

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THIS study reflects a resurgence of interest in the therapeutic use of radioisotopes in neoplastic diseases. It will be noted that less attention is given to organic nitrogen compounds, but folic acid antagonists and hormones reach a new peak of interest as anticancer agents. Cortisone, ACTH, estrogens and androgens comprise almost one-half of the clinical trials presented, whereas antibiotics, vitamins and blood transfusions are the most frequently tested miscellaneous agents. This article brings the number of papers on clinical trials surveyed by the writer to 1,075.[186]

INORGANIC CHEMICALS

Radiogold. Au-198 has been employed clinically for prostatic carcinoma,[65,66] cancer of the female reproductive tract,[1,83,174,196,201] myeloid leukemia[63] and neoplastic effusions.[90,114,149,179,198]

Radiophosphorus. P-32 has proved useful in the treatment of polycythemia,[63,91,123,158,199,202,211] chronic myelocytic leukemia,[137,202] acute leukemia,[163] adenocarcinoma of the tongue,[151] metastases of the bone[69] and lymphosarcoma.[175] Radioactive colloidal chromic phosphate gave encouraging results in patients with prostatic carcinoma.[185]

Radioiodine. Favorable reports on the use of I-131 for neoplasms of the thyroid continue to appear in the literature.[16,41,93,119,131,154,166,172,212]

Radiocobalt. Co-60 has been used to treat cancer of the head and neck,[50,63,103,124] cancer of the bladder[150] and neoplasms of the lung, rectum, uterus, etc.[138,190]

Radioarsenic. Marchal et al.[134–137] have reported the application of As-76 in the treatment of mycosis fungoides and Hodgkin's disease.

Radiosodium. Na-24 proved effective in the treatment of thoracic carcinoma.[63]

Radon Seeds. Implants have been made in the pituitary of patients with cancer of the breast.[67]

ORGANIC NITROGEN COMPOUNDS

Nitrogen Mustards. Nitrogen mustards continue to be used extensively in the treatment of bronchogenic carcinoma,[125,127,139,170,197,200] Hodgkin's disease and allied neoplasms,[40,95,108,109,130,153] chronic leukemia,[73,116] multiple myelomatosis[100] and epithelioma.[165] Combined with aureomycin, nitrogen mustards inhibited sarcoma of the bone,[117] and with citral they prolonged the lives of patients with cancer of the throat, stomach, etc.[157]

TEM. Several investigators have described the use of triethylene melamine in the treatment of chronic lymphocytic leukemia,[15,29,33,128,140,156] Hodgkin's disease,[29,109] lymphogranulomatosis[54,128] and intrathoracic malignancies.[200]

Amines. Mercaptoethylamine inhibited lymphatic leukemia[6,23] and lymphosarcoma.[78] β-naphthyl-dichloroethylamine gave good results in patients with polycythemia vera.[102]

Phosphoramides. Triethylenethiophosphoramide, TEPA, has proved effective against Hodgkin's disease,[23] granulocytic and lymphocytic leukemia,[222] and carcinoma of the breast and ovary.[195] 1,3-Bis-(ethyleneimio-sulphonyl)-propane caused six remissions in twelve patients with chronic myeloid leukemia.[159]

Thiouracil. Chronic myeloid leukemia responded to thiouracil therapy,[19,22] and this chemical helped tumors absorb I-131 in patients with carcinoma of the thyroid.[119]

Urethan. This compound induced remissions of granulocytic leukemia[140] and multiple myeloma.[100]

6-MP. 6-Mercaptopurine induced remissions in chronic myelocytic[39] and blastic leukemias.[48]

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Desoxypyridoxine. The course of acute lymphatic leukemia was modified somewhat by this agent.[213]

Diaminopyrimidine. The folic acid antagonist, DDMP, caused remissions in acute leukemia.[152]

8-*Azaguanine.* Acute leukemia was retarded by 8-azaguanine.[42]

Amino Acids. N-bis-β-chloroethylalanine showed promising results in the treatment of leukemia.[101]

Thiazine. Several thiazines were effective in relieving pain in cancer.[61]

FOLIC ACID ANTAGONISTS

Aminopterin. Aminopterin has been useful in the treatment of acute leukemia* and in childhood leukemia.† Combined with ACTH, aminopterin induced remissions in acute lymphatic leukemia,[62,143] and with cortisone it also retarded acute leukemia.[20,62,132,176] Transfusions and aminopterin caused good remissions in childhood leukemia.[176]

Amethopterin. This folic acid antagonist prolonged the lives of children with leukemia.[122,167,216]

HORMONES

Estrogens. Stilbestrol therapy has been widely used in prostatic cancer[28,71,89,94,115] and in cancer of the breast.[89,125] Olson[155] reported no objective evidence that this hormone had any effect on bronchogenic carcinoma. Diethylstilbestrol also has been widely used in the treatment of prostatic cancer[31,121,203,210] and advanced cancer of the breast.[97,112,207] TACE® was effective in the treatment of carcinoma of the prostate.[65,82] The synthetic estrogen, distilbene, was useful in adenoma of the hypophysis[35] and progesterone has proved beneficial in treating neoplasms of the cervix.[182] Göbel,[79] Ricklin[178] and Zimmer[224] have reported the use of estrogens in the treatment of cancer of the prostate, while Flocks,[66] Kambe et al.[110] and Kennedy et al.[111] have employed female hormones in treating cancer of the breast. Adrenalectomy and ovariectomy benefited patients with neoplasms of the breast.[86]

Androgens. Numerous reports have been made on testosterone therapy for advanced cancer of the breast.* Olson[155] reported that this male hormone produced no objective evidence of improvement in patients with bronchogenic carcinoma, and Segaloff et al.[191,192] found no regression in carcinoma of the breast following the use of androstenediol; these same investigators reported that only two of twenty-one patients with neoplasms of the breast responded objectively to vinyl testosterone.[193] Kennedy[112,113] studied the effects of testosterone, stanolone and other sex hormones on cancer of the breast.

Cortisone. Cortisone has had wide application in the therapy of acute leukemia,† and combined with folic acid antagonists it has been effective in acute leukemia,[20,37,62,132,177] Hodgkin's disease[62] and lymphosarcoma.[62] Remissions have also been secured with cortisone in chronic myeloid leukemia,[23] chronic lymphatic leukemia,[57] lymphosarcoma,[57] multiple myeloma,[57,118] Hodgkin's disease,[109] prostatic carcinoma,[82,84,208] lymphogranuloma[54,55] and chronic erythroblastosis.[76] Combined with nitrogen mustard, cortisone has been used in the palliation of advanced neoplastic diseases.[130] Tivey[206] concluded that the hormone was ineffective in lymphocytic, granulocytic and monocytic leukemias.

ACTH. ACTH has had extensive application in the treatment of acute leukemia,[21, 27,37,44,163,173,194,219] and combined with folic acid antagonists it induced remissions in acute leukemia.[37,62,143] The hormone was effective also in treating lymphomas[57,68] and pulmonary carcinoma.[8,88] In combination with nitrogen mustard, ACTH produced unusual remissions in Hodgkin's disease and in neoplasms of the breast, lung and pancreas.[130] Tivey[206] noted that ACTH was ineffective in treating lymphocytic, granulocytic and monocytic leukemias.

Adrenals. Adrenalectomy has produced improvement in patients with advanced prostatic cancer[17,82,205] and cancer of the breast.[17,76,205] A combination of adrenalectomy, castration and hormone therapy has resulted in remissions in cancer of the breast.[207] Desoxycorticosterone relieved radiation sickness.[58]

Pituitary. Pituitary hormones were effective in treating carcinoma and sarcoma of the breast, ovary, etc.[92,99] Hypophysectomy in-

* See references 18, 52, 53, 57, 62, 105, 122, 132, 142, 167, 216, 218.

† See references 57, 75, 104, 105, 122, 143, 148, 163, 167, 177, 206, 216.

* See references 2, 3, 45, 46, 74, 110, 111, 125, 168, 207, 217.

† See references 21, 27, 36, 43, 44, 75, 143, 169, 204, 219.

duced remissions in neoplasms of the breast and prostate, and in malignant melanoma.[129,160]

Thymectomy. The short-lived physical improvement of patients undergoing thymectomy for lymphatic leukemia was not sufficient to justify this operation in the judgment of Dean et al.[47]

Orchiectomy. Gahagan and Fischman[71] concluded that orchiectomy was more effective than stilbestrol therapy for patients with prostatic carcinoma.

MISCELLANEOUS AGENTS

Antibiotics. Terramycin® has proved helpful in treating Hodgkin's disease,[10,11,12] lymphomas[9,12] and cirrhosis of the liver.[51] Streptomycin also was effective against leukemia[26] and Hodgkin's disease;[11,12] actinomycin was useful in treating similar neoplastic diseases.[24,171,187] A combination of antibiotics and transfusions proved useful in leukemic patients.[26,37,106,107] Klopp[117] treated sarcoma of the bone with a combination of aureomycin and nitrogen mustard, and Bateman et al.[14] employed this antibiotic and x-rays in far advanced neoplasms. Fatal complications following intensive antibiotic therapy have been reported by Bateman et al.[13] and Decourt et al.[49] Wright et al.[221] noted no alteration in the progressive downhill clinical course of patients with a variety of neoplastic diseases following puromycin therapy.

Vitamins. High dosages of vitamins A and C have improved the condition of patients with cancer of the uterus[215] and carcinoma of the stomach, rectum and pylorus.[189] Treatment with vitamins B and C produced good palliation in patients with cancer of the breast, lungs, etc.,[209] but large doses of B_{12} did not alter the clinical course of leukemic patients.[214] Vitamin P increased the tolerance of patients to radiation.[5] Huant[96] and Dubois-Ferriere[54] also studied the effects of vitamins on neoplasms.

Transfusions. A number of studies have been made on replacement transfusions in leukemia.[70,81,87,106,107,148,181]

Butazolidin.® Chronic myeloid leukemia and lymphomas have responded to this agent.[59,85,120,183]

Synkavit. Patients with bronchogenic carcinoma lived longer when synkavit therapy was combined with radiation.[144–146]

Myleran.® Remissions followed the use of this agent in chronic myeloid leukemia.[32,126]

Alcobols. Alcohol injections have been used to control pain in patients with cancer.[34,164]

Ether Inhalation. Advanced carcinoma of the breast and prostate responded to this therapy.[162,223]

Resins. Cation-anion exchange resins improved the clinical condition of patients with hepatic cirrhosis.[25,180]

Alkaloids. A new Colchicum alkaloid, demecolein Ciba, gave good results in the treatment of myeloid leukemia.[147] Metopon and morphine were effective analgesic drugs in cancer therapy.[56]

Enzymes. Patients with carcinoma responded to succinoxydase.[60]

Splenectomy. Splenectomy prolonged the lives of leukemic patients.[64,98]

Viruses. Egypt 101 virus induced regression in carcinoma of the stomach, rectum and liver.[72]

Colchicine. Brief remissions in Hodgkin's disease were noted with this agent.[80]

Citral. Citral and citronellal injected simultaneously prolonged the lives of patients with cancer of the throat, stomach, etc.[157]

Polydyn. Carcinoma of the breast, ovary, bronchus, etc., responded to this agent.[188]

Podophyllin. Basaloma responded to this agent.[161]

Quinones. Several quinones, when combined with x-rays,[4] showed cytostatic action on fibrosarcoma and reticulosarcoma.

Serum. Cobra serum brought relief from pain to patients with various neoplasms.[30] Prof. Bagomeletz's serum showed some palliative effects in patients with metastatic carcinoma.[184]

Honvan. This agent inhibited prostatic carcinoma.[38]

Megaphen. This agent alleviated pain in patients with cancer.[141]

Liver Extracts. A few patients with carcinoma of the stomach and with bronchial carcinoma were benefited by liver extracts.[133]

Psychosomatic Factors. A study has been made of psychosomatic factors in the management of cancer in human beings.[7,77]

Hyperthermal Bath. A few patients with erythremia responded to combined roentgen and ultrasonic therapy.[220]

Acknowledgment: The original literature has been made available by the Armed Forces medical library and the libraries of Fur-

man University and the Greenville General Hospital.

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Inguinal and Femoral Hernia

A REVIEW OF 1,694 CASES

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INGUINAL and femoral hernia in the adult is a major and troublesome problem.

This review was undertaken in an effort to determine accurately the end results of the various operative procedures as noted by personally examined postoperative patients. Many

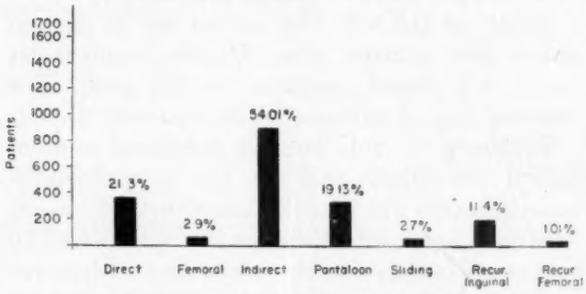

FIG. 1. Comparative incidence of hernia type.

of the published statistics [*2,4,5,6,8,12,14,17, 18,20*] are based on a one to two year follow-up on the presumption that most recurrences appear within two years of operation. Recent reports [*2,4,6,8*] suggest that this period is too short. A five year follow-up period was selected. All patients who were not followed up for at least five years subsequent to operation were not included in the evaluation of recurrence. The recall was effective in 1,124 patients or 71.2 per cent.

The experience at the Veterans Administration Hospital at Cleveland, Ohio, was reviewed for the period between June 15, 1946 and June 15, 1950. During this period 1,694 hernioplasties were performed upon 1,580 patients. All but one of the patients were male veterans, ranging in age from nineteen to eighty-four years. The majority were between twenty and sixty years of age.

In Figures 1 and 2 the hernias are classified according to type, age of patient and comparative incidence. There were 162 bilateral hernias with a total of 324 sides or 19.1 per cent of the entire group.

The distribution according to the side involved was most interesting. Femoral hernias were almost twice as common on the right

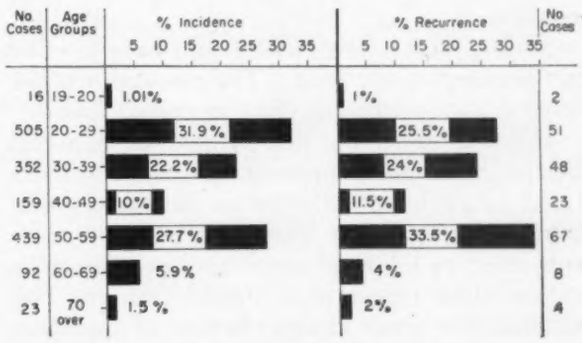

FIG. 2. Age incidence.

side. Primary, indirect and direct as well as recurrent hernias were distinctly more common on the right side.

The relationship of age to type of hernia is indicated in Table I. Although the incidence of direct hernia in the older age group is increased, indirect hernia in the aged and direct hernia in the young is not uncommonly encountered.

It should be observed that femoral hernia is found fairly evenly distributed in the 30 to 50 year age group.

Only 21.3 per cent of the hernias were direct. Indirect hernias predominated in a ratio of three to one.

The probability of recurrence after operation is distinctly greater for direct hernia as compared to indirect hernia (Table II), and is 60 per cent greater in a femoral hernia than in

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TABLE 1
RELATIONSHIP OF AGE TO TYPE

Type of Hernia	Total		Age Groups						
	No.	%	19–20	20–29	30–39	40–49	50–59	60–69	Over 70
Direct	360	21.3	3	115	80	36	100	21	5
Indirect	915	54.01	10	293	203	92	250	53	13
Femoral	50	2.9	0	16	11	5	14	3	1
Pantaloon	324	19.13	3	104	72	32	90	19	4
Sliding	45	2.7	0	14	10	5	13	3	0
Total	1,694	.....	16	542	376	170	467	100	23

a direct hernia. The pantaloon or indirect-direct hernia was found in 324 patients or in 19.13 per cent of the total. Failure to recognize the presence of the double component or a femoral component is a leading factor in recurrence.

Sliding hernia was noted in forty-five or 2.7 per cent of the group. The sigmoid was the most common element (62.2 per cent) found.

Bilateral Hernia. The subject of bilateral hernia is of great interest as many authors [*4,5,8,12,14*] have indicated an increased possibility of recurrence when the patients were subjected to bilateral simultaneous operations rather than repair in a staged fashion. The difference in result as regards time of operation has not been apparent in our series nor, as far as we could determine, has the incidence of postoperative complications been in any way affected by the length of the procedure.

The decision as to whether or not the operations should be performed as one or two procedures was determined initially by the nature of the hernias and the difficulties encountered in doing a satisfactory repair rather than by the single fact that they were bilateral. The procedures performed during the latter part of this study were at no time simultaneous. These therefore served as a control group.

The difference in the recurrence rate between our cases in which repair was simultaneous and those in which repair was one week apart is statistically insignificant.

Methods of Treatment. Major differences in technic only have been considered in the classification of these cases.

Bassini method [*19,20*]: The main steps consist of high ligation of the sac and suturing of the aponeurotic layer of the transversus muscle and transversalis fascia lateral and medial to the spermatic cord, at the internal ring, to the reflected portion of Poupart's ligament.

Halstead [*19,20*]: The hernia sac is excised above the internal ring. All the aponeurotic layers are closed posterior to the cord. The internal ring is narrowed.

Ferguson [*19,20*]: The sac is treated as mentioned heretofore and all the musculoaponeurotic layers are sutured anterior to the cord.

McVay [*13,15*]: Lothheisen in 1898 devised an operation mainly for the treatment of femoral hernias which remained obscure until other investigators [*1,2,5,9,17*], especially McVay and Anson [*15*], popularized the utilization of Cooper's ligament in the repair of inguinal hernia. This is of especial importance in the repair of direct hernia. Relaxation incisions are occasionally indicated in this procedure.

Andrews [*1,20*]: This involves imbrication of the leaves of the external oblique muscle aponeurosis with the cord between the leaves after high ligation and excision of the sac.

La Roque [*10,11*]: In this useful approach to the sac in a sliding hernia an associated muscle-splitting incision is made above the classic incision and the hernia reduced transperitoneally with pertinent mesenteric fixation accomplished. The remainder of the repair is completed according to the preference of the surgeon.

In all our procedures, the integrity of the floor of Hesselbach's triangle and the size of the femoral ring is always tested by the forefinger through the opened indirect sac.

TABLE II

ANALYSIS OF ALL RECURRENCES (NUMERATORS) COMPARED WITH ALL CASES FOLLOWED UP (DENOMINATORS), INCLUDING RECURRENT HERNIA

Type of Repair	No. of Recurrences	Cases in Group	Type of Hernia—All				
			Indirect (41%)	Direct (8.6%)	Femoral (4.1%)	Pantaloon (18.9%)	Sliding (7.3%)
Bassini	70	70/692 (10.1%)	39/600 (6.5%)	13/65 (20%)	4/4 (100%)	12/65 (18.4%)	2/12 (16.9%)
Halstead	12	12/88 (13.9%)	5/55 (9.9%)	4/16 (25%)	0/0 (0%)	3/14 (21.5%)	0/0 (0%)
McVay	34	34/235 (14.4%)	5/33 (15.1%)	10/158 (6.7%)	5/30 (6%)	10/142 (7.1%)	3/9 (33%)
McVay-Halstead	4	4/33 (12.1%)	1/5 (20%)	1/4 (25%)	0/2 (0%)	2/10 (20%)	1/3 (33%)
Other Bloodgood-Andrews	2	2/7 (29%)	0/3 (0%)	1/2 (50%)	0/0 (0%)	0/0 (0%)	0/0 (0%)
Bassini-LaRoque	0	0/3 (0%)	.....	.....	.....	.....	3/0 (0%)
Totals	122	122/1124 (10.8%)	.....	.....	.....	.....	.....
Recurrent Hernia Alone							
Totals	...	.....	12/79 (15.2%)	8/75 (10.7%)	4/8 (50%)	3/29 (10.3%)	.....

Table II presents an analysis of recurrences in combined table form, thereby offering comparative results at a glance.

It is not surprising that the lowest incidence of recurrence is found in the indirect group, with the greatest incidence following repair of recurrent femoral hernia inasmuch as the amount of manipulation required for the former is far less than that required for the latter, as well as because of the difference in the pathogenesis of each entity.

Site of Recurrence. The interval between operation and recurrence during a five year period is presented in Figure 3. The shortest period was two weeks, the longest five years.

Twenty-eight of the 122 patients known to have recurrences have had secondary procedures at this hospital. Although the number is small, it is nonetheless statistically significant inasmuch as eight or 29 per cent of the twenty-eight patients had direct hernias—slightly greater than the expected incidence. Ten or 36 per cent had indirect hernias—much lower than the usually computed incidence. (Table III for comparisons.)

This study of our failures was supplemented

by the findings in 200 patients who had a repair elsewhere and then came to us for correction as shown in Table IV. The type of recurrence and the repair found would indicate that indirect hernia was probably the primary finding when only an indirect sac with a Bassini

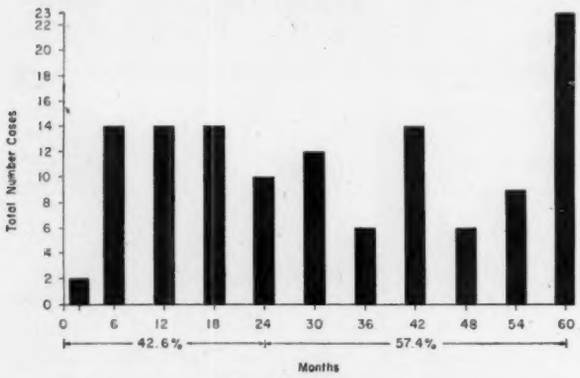

FIG. 3. Interval between operation and recurrence.

repair was found. The presence of a direct recurrence with a Bassini repair cannot be adequately evaluated inasmuch as repair was made in many of these cases prior to the classic article by Anson and McVay in 1942 [*15*].

Table II effectively indicates that where a direct or pantaloon hernia is encountered a Cooper's ligament type repair is distinctly indicated, but is probably of no real value in the repair of an indirect hernia.

Suture Material. Silk was used in 81.7 per cent of the cases, cotton in 17.7 per cent, catgut in three cases and skin in four cases.

Additional Operations. Various local additional operations were performed at the time of repair. These apparently were not factors in the recurrence ratio. These include hydrocelectomy.

Postoperative Complications. Thirteen cases, or 7.9 per cent of the total, were complicated by a variety of conditions. The largest

TABLE III

TYPE OF RECURRENCE WITH TYPE OF ORIGINAL HERNIA AND PRIMARY REPAIR

Original Hernia	No. of Cases	Primary Repair		Recurrence		
		Type	No.	Indirect	Direct	Femoral
Indirect	10	Bassini McVay Halstead	6 1 3	5	5	0
Direct	8	Bassini McVay Halstead	2 5 1	3	5	0
Femoral	5	McVay	5	..	..	5
Indirect and femoral	4	Bassini	4	..	..	4
Direct and femoral	1	McVay	1	..	..	1

TABLE IV

HERNIA REPAIR AT ANOTHER HOSPITAL WITH SECONDARY REPAIR AT CLEVELAND VETERANS ADMINISTRATION HOSPITAL (200 CASES)

Recurrence Encountered		Repair Encountered					
Type	No.	Bassini	McVay	Halstead	McVay-Halstead	Andrews	Ferguson
Indirect (39.5%)	79	56	4	17	1	1	0
Direct (32.5%)	75	48	9	16	0	2	0
Pantaloon (14.5%)	29	20	2	3	1	0	3
Femoral (4%)	8	2	5	0	1	0	0
Indirect and femoral (0.5%)	1	1	0	0	0	0	0
Direct and femoral (3%)	6	3	3	0	0	0	0
Pantaloon and femoral (1%)	2	1	1	0	0	0	0

TABLE V
SLIDING HERNIA TYPE AND REPAIR
(TOTAL 45—2.7%)

Type	No.	Repair					
		Bassini	McVay	McVay Halstead	Halstead	Bassini LaRoque	Bassini McVay
Sigmoid (62.22%)	28	17	5	2	1	2	1
Cecum (15.5%)	7	7	0	0	0	0	0
Urinary bladder (15.5%)	7	4	0	2	1	0	0
Appendix and femoral (4.4%)	2	0	2	0	0	0	0
Small intestine direct (2.2%)	1	0	1	0	0	0	0

groups are pulmonary diseases, operative site hematoma and local infection. There were no postoperative deaths. The complications did not seem to play a role in the recurrences with the exception of wound infection. Late atrophy of the testis was noted in eighteen or 1.37 per cent of the cases followed.

Thrombophlebitis was relatively uncommon. It was encountered forty-one times or 2.5 per cent. These figures are similar to those for other major operative procedures despite early ambulation, a routine practice at this institution.

Anesthesia. Spinal anesthesia was used in over 95 per cent of the cases. The reasons for using another anesthetic modality varied from cardiovascular debility to patient refusal. Local anesthesia was used in fifty-two cases or 3.2 per cent. Cardiac arrest occurred in one case with early transthoracic resuscitation and complete recovery.

Sliding Hernia. There were forty-five or 2.7 per cent sliding hernias. These were repaired as noted in Table v with a 15.8 per cent of recurrence.

Incarceration. Patients requiring emergency surgery were of relatively infrequent occurrence in this review. Only thirty-six or 2.12 per cent were in this group. In this group none required a major intestinal resection. Several appendectomies were performed. This is not recommended as a routine procedure. Seventy-two and two-tenths per cent were indirect.

It is of interest that there was a significant number of direct hernias (13.9 per cent) with incarceration equal in number to the incarcerated femoral hernias, i.e., five of each—suggesting that direct hernia in the aged is not an entirely benign state.

Femoral Hernia. This material will be exhaustively evaluated in a later paper.

The youngest patient was thirty, the oldest fifty-nine years of age.

Four of the patients with femoral hernia were operated upon originally for inguinal hernia, indicating that perhaps the femoral component was not recognized at the time of the original procedure.

Seventeen of the cases were recurrent, an incidence of 34 per cent of the total number of femoral hernia. Of this group five or 29.1 per cent recurred as compared to a 21 per cent recurrence rate for primary femoral hernioplasty.

SUMMARY AND CONCLUSIONS

A review is presented of 1,694 inguinal and femoral hernioplasties performed upon 1,580 patients with a personal follow up of 71.2 per cent in five years.

The operations were performed predominately by the resident staff.

The recurrence rate for indirect hernia was 6.7 per cent corrected to 5.6 per cent for primary hernia; for direct hernia 7.6 per cent corrected to 5.7 per cent for primary hernia; pantaloon hernia 8.3 per cent corrected to 7.7 per cent for primary hernia; femoral hernia

22 per cent corrected to 21 per cent for primary hernia.

The greatest number of occurrences were encountered in the eighteen month to four year range.

In indirect hernia the essential steps are high excision with ligation of the sac and adequate closure of the internal ring about the cord.

In direct hernia very special attention must be given to repairing the floor of Hesselbach's triangle utilizing Cooper's ligament.

Femoral hernioplasty requires great care and skill and will probably offer the lowest recurrence rate if a Burton-McVay technic is followed.

Bilateral operations performed simultaneously do not result in an increase of recurrence as compared to staged procedures.

Follow-up should be of the order of a five year minimum with physician re-examination required. Questionnaire follow-up is valueless.

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Repair of Inguinal Hernia

A FOURTH PRINCIPLE AND MODIFIED TECHNIC

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THE repair of inguinal hernia, although well documented and standardized, is still subject to refinement and improvement. The still prevalent 10 per cent incidence of recurrence more specifically challenges thought and action in this direction [8].

Although hundreds of modifications and special technics have been devised, all with merit, three basic principles in the repair of inguinal hernia remain. All these principles depend on the layer of the abdominal wall above which the cord is to be transplanted. The first and simplest operation, performed mainly in children, employs the principle of dissection and obliteration of the hernial sac with high ligation of the indirect sac at its junction with the general peritoneal cavity; simple closure is done over the cord of the defect in the abdominal wall as occupied by the sac and the conjoined tissues are sutured to the shelving edge of the inguinal ligament [8]. This procedure, known as the Ferguson operation, has been generally accepted as sufficient for the treatment of inguinal hernia in children. This operation is also employed in patients with a direct sac or when combined direct and indirect components are present, or even in the case of a continuous congenital sac which involves a continuation of the hernial sac with the tunica vaginalis.

In the Bassini operation [2] the principle of transplantation of the cord above the natural muscle level marks the surgeon's first understanding of the deficiencies of the inguinal region which exist in the phenomenon of inguinal hernia. By transplanting the spermatic cord above the internal oblique muscle before it is sutured to the shelving edge of the inguinal ligament, it is acknowledged that a structural change has taken place in the region of the muscles of the lower abdomen. This change has rendered the area prone to the spreading of muscle fibers adjacent to the internal inguinal ring with vulnerability to recurrent herniation. Anatomists have always indicated that as the last fibers of the internal oblique and transversus abdominis muscles inserted into the lateral aspect of the rectus sheath in its proximity to the tubercle, they form a firm tendinous structure, blending together and fastening themselves to the rectus sheath in the inferior border of Hesselbach's triangle. Surgeons performing herniorrhaphy have sometimes found it difficult to identify the conjoined tendon, particularly when considerable hernial disease has been present and have found it necessary to suture the lateral border of the rectus fascia to the shelving edge of the inguinal ligament in the lower portion of the hernial repair. It is probable that the conjoined tendon exists more favorably in those specimens examined without surgical hernial disease, and that the relative absence of the conjoined tendon has some bearing on the condition which is responsible for the herniation being present. At any rate, the approximation of tissue to the inguinal ligament and the resultant tension in this area in a certain proportion of cases led to the third step of recognition of physiologic and anatomic deficiencies in the inguinal area.

The Halsted operation [3] encompasses the transplantation of the cord through the external oblique fascia and the closure of the fascia under the cord, usually with an overlapping, so as to strengthen the lower inguinal region further. In addition, careful closure of the fascial ring about the cord is done to prevent further herniation through the indirect route. Double transplantation of the cord was especially designed to prevent recurrence when a direct sac or direct component is found. The

underlying motive was to provide tissues strong enough to attach to the inguinal ligament reflection in the lower part of Hesselbach's triangle, where the obvious presence of a large bulge and the absence of strong fibrous or thick muscular tissues in this area has allowed this bulging to be present. The Halsted procedure also found favor in the repair of recurrent hernias, particularly in the repair of recurrent hernias in which a direct component or direct recurrence was observed.

Recurrence rates in inguinal hernia remain sizable in spite of the intelligent applications of these three basic principles to the various types of hernias found, and in spite of the improvement in surgical technic and type of suture material used. Surgeons have sought new ways to overcome the problem of having to reperform an operation which had been successful the year before.

In the opinion of the authors, the following innovations have been among the most successful during the last two decades. (1) Anson and McVay's method [1] of suturing the transversalis fascia and the conjoined tendon to Cooper's ligament instead of the reflected edge of the inguinal ligament; (2) the formation of a flap [4] from the anterior leaf of the rectus sheath and the utilization of this flap as a substitute for good tissues in the inguinal defect; (3) free transplant of a flap of fascia lata [6] to cover the defect in the area; (4) the relaxing incision made in the anterior rectus sheath and suture of the reflected sheath to the shelving edge of the inguinal ligament; and (5) careful isolation and closure of the transverse abdominis muscle before a hernial repair is performed.

The principle of inserting tissues and fascia into the hernial defect without suturing the conjoined tendon to the shelving edge of the inguinal ligament constitutes a fourth principle in the repair of inguinal hernia. This principle is particularly important when widening of the lower portion of the abdominal wall has occurred due to relaxation of the abdominal musculature or thinning of the lower fibers of the internal oblique muscle. With the exception of deflecting the anterior sheath of the rectus, it is difficult to obtain autogenous tissue to fill this defect.

Advances in the field of medicine have often come with the introduction of substances from other scientific endeavors. Tantalum wire mesh [7] and stainless steel wire mesh [5] were introduced into surgery for the purpose of forming a latticework in which connective tissue could grow. These substances were first used in connection with ventral hernias and recurrent inguinal hernias which required prosthetic inserts to be adequately repaired. Such prosthetic inserts were found to be quite valuable and have been quickly accepted throughout this country.

Microscopic studies show that not only does metallic mesh act as a support during the healing process, but also connective tissue grows through the apertures of the metal and forms a dense fascia-like structure which in time is many times stronger than the mesh itself. Tantalum mesh and stainless steel mesh each have their advantages. Stainless steel mesh is easier to handle and less likely to break off; on the other hand, tantalum mesh has been shown to be less reactive to tissue than stainless steel mesh, and the instances of serous effusions are less with the tantalum material than with the stainless steel. Even if fragmentation does occur, the connective tissue stroma developing in the tantalum mesh soon overcomes the weakness to fragmentation in practically every instance. These two internal prostheses have been widely utilized in the repair of recurrent hernias. Surgeons have been reticent, however, to substitute the new for the old, and there has been a delay in the employment of these new materials in the primary repair of inguinal hernias. During the last five years we have employed a prosthesis of stainless steel wire mesh in the repair of primary direct and indirect inguinal hernias in cases in which we thought widening of the abdominal wall was present. The procedure has been standardized as follows.

An incision is made parallel to the inguinal ligament, starting approximately 2 inches medial to the anterior iliac spine, down to the region of the pubic tubercle. The incision is carried through the skin, subcutaneous tissue and Scarpa's fascia, the external oblique aponeurosis being exposed. Incision is made in the internal oblique fibers between bundles of fascia from a point approximately 3 inches above, down to and through the external inguinal ring, care being taken to expose and avoid cutting the ilioinguinal nerve. The leaves of the external aponeurosis are carefully dissected free from the underlying muscle, both

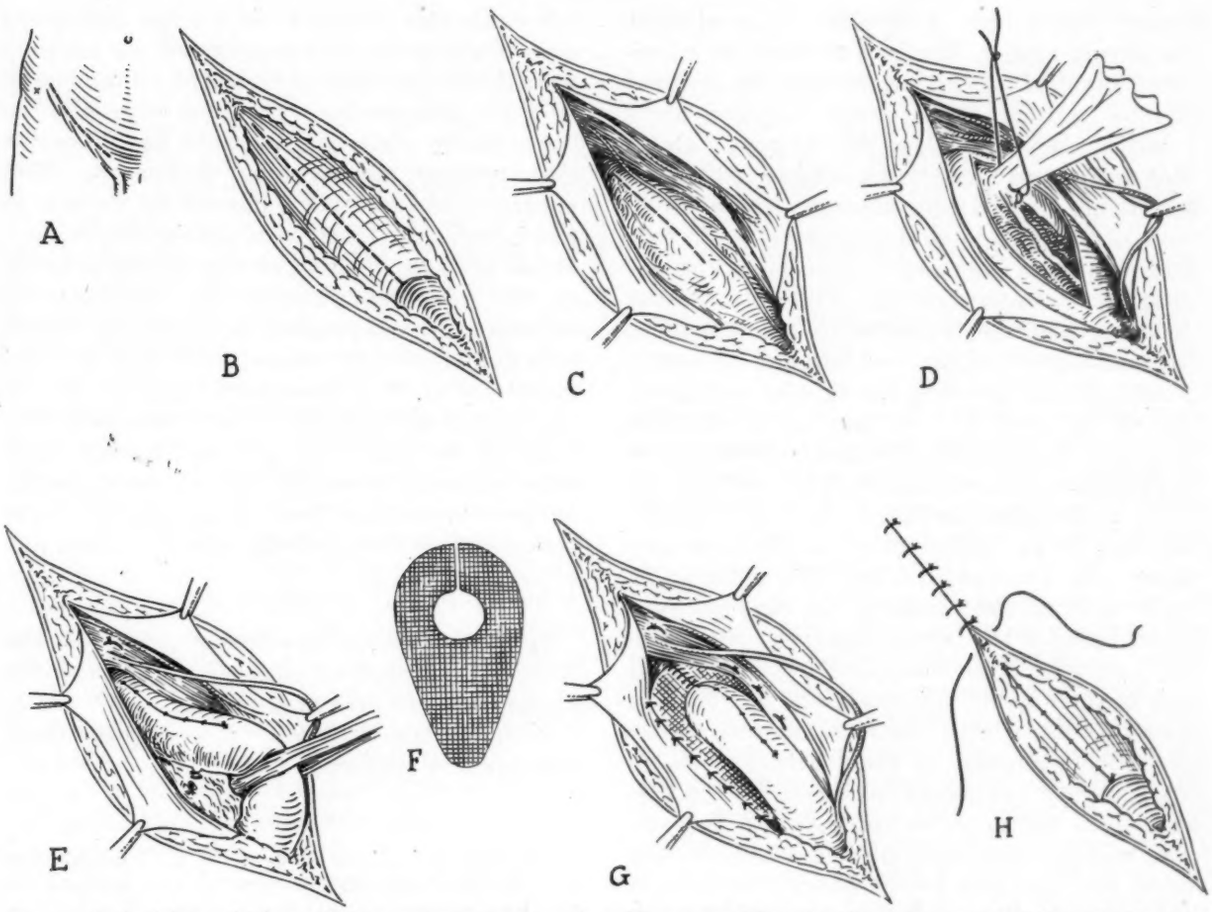

FIG. 1. A, incision 1 inch medial to anterosuperior spine down to pubic tubercle. B, external oblique fascia and external ring exposed; incision through fascia opening ring. C, incision through cremaster muscle over bulge of hernia using scissors. D, isolation, opening, dissection and ligation of indirect sac, separating vas deferens from sac. E, implantation of ligation suture through internal oblique muscle; closure of incision into cord; elevation of cord and division of spermatic branches of inferior epigastric vessels. F, preparation of stainless steel wire mesh insert. G, wire mesh *in situ*, sutured to shelving edge of inguinal ligament, to top of rectus fascia and top of internal oblique muscle, ilioinguinal nerve elevated. H, closure of external oblique fascia, reconstructing original external ring; closure of skin with vertical mattress sutures.

medially and laterally, cleaning the shelving edge of the inguinal ligament laterally and exposing the sheath of the rectus muscle medially. Attention is then given to the dissection of the spermatic cord. It is our procedure to dissect the spermatic cord free from the upper extremity to the scrotum, all communicating vessels between the cord and the subcutaneous tissues being doubly clamped, divided and ligated carefully. In the technic of freeing the cord completely we note that there is an almost constant communicating artery and vein coming up from the inferior epigastric vessels to the cord. If this is looked for and doubly clamped, divided and ligated, much of the difficulty of the entire procedure is avoided as the cord becomes much freer and easier to move out of the way. The indirect hernial sac is then located; it is always found in the anteromedial aspect of the upper portion of cord. An actual incision of the cremasteric fibers between two forceps with a pair of scissors is advisable so as to open the cremasteric layer of the cord cleanly. The incision is made large enough so that the sac may be pulled out without further tearing of the cremaster. The cremasteric incision is important, for when dissection of the sac is completed the cremaster fibers may be closed and the cord restored to its tubular character. The sac is next opened, the finger is inserted into the sac and the remainder of the sac is carefully dissected free from the surrounding tissues of the cord. The sac is transfixed at its junction with the peri-

toneal cavity by a double figure-of-eight transfixion suture. We find no harm in transfixing the neck of the sac through the internal oblique muscle at a point approximately 2 inches above its edge. We strongly believe that any excess fatty tissue accompanying the sac should be carefully dissected and excised, as it is our opinion that a finger of fat in the first portion of the cord is sometimes the advance part of a hernial sac. With only the vas deferens, the vascular portion of the cord and the musculature of the cord left, the cremaster is next closed, restoring the tubular configuration of the cord. An oval segment of stainless steel wire mesh is then cut and fashioned so as to fit into the inguinal region. A slit and hole are made in the upper portion of the oval segment, the hole being fashioned so as to fit snugly about the remodelled cord. No attempt is made to draw the tissues to the inguinal ligament; instead, the lateral margin of the stainless steel wire mesh is sutured to the reflected edge of the inguinal ligament. The medial edge is made to lie on top of the rectus sheath, a little slack being allowed so that there will be no tension when the patient is erect. The cord is fitted into the aperture through the slot and the stainless steel wire mesh is closed snugly about the cord and to the anterior surface of the internal oblique muscle above the cord. The external oblique aponeurosis is closed simply over the wire mesh down to the original region of the external ring which has been previously marked by placing a suture there originally. Scarpa's fascia is closed and the skin is closed with interrupted sutures. Figure 1 demonstrates graphically the procedure which we have described.

Although this procedure has been performed for primary hernial repair in only twenty cases to date, certain immediate advantages have become apparent. The postoperative period has been marked by a relative absence of pain. The necessity for narcotics on the usual four-hour schedule is rare. Patients are able to ambulate on the same day or on the following day without distress, and even coughing does not cause the patient to experience significant pain in the groin. The majority of our patients were discharged from the hospital on the fourth or fifth postoperative day and were able to come to the office on the eighth postoperative day without experiencing discomfort. Skin sutures were routinely allowed to remain in place until the fourteenth postoperative day. It has been our practice to remove the dressing on the first postoperative day, allowing the sutures to remain exposed to the air. No wound infections have been encountered and no accumulations of fluid have been noted in any of the hernias repaired thus far. Two hernias were repaired five years ago and the majority have been repaired as recently as eighteen months before this writing. None of our patients have shown any evidence of recurrence to date.

SUMMARY

1. A brief review has been presented of the principles of repair of inguinal hernia, with the elaboration of a fourth principle.

2. A method of repair using stainless steel wire mesh is suggested.

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Gastrojejunocolic Fistula: A New Surgical Modification

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THE treatment of gastrojejunocolic fistula is surgical. Earlier procedures directed toward eliminating the fistula and restoring the continuity of the gastrointestinal tract have resulted in recurrences of either the original duodenal ulcer or marginal ulcers in 25 to 50 per cent of cases. Therefore, all present procedures are devised to eliminate the fistula and correct the ulcer diathesis. There is no unanimity of opinion as to the best method for achieving this result and the technical approaches have varied considerably in the attempt to lower both the morbidity and the mortality.

Pfeiffer and Kent[1] started the trend toward a reduced mortality with the successful employment of preliminary ascending loop colostomy followed, at a varying interval, by second stage removal of the fistula and gastric resection. Lahey and Marshall,[2] Mathewson,[3] and Lawton and Marks[4] have contributed various modifications of Pfeiffer's procedure. As recently as 1953, Localio et al.[5] reported the use of single stage block dissection of the fistula in eight cases without a single death. If the fistula was large, resection and end-to-end reanastomosis of the colon and the jejunum accompanied by subtotal gastric resection were employed. If the fistula was small, a more modest closure of the openings in the colon and jejunum and gastric resection were performed.

Since it is our belief that each case must be individualized and that there should not be an unequivocal application of a single procedure to all cases, we are reporting a new modification of combined vagotomy and Pfeiffer colostomy performed in one stage, followed, at an interval, by second stage resection of the fistula and gastric resection. This procedure is of value when a large fistula is present with severe inflammatory changes in the surrounding area contraindicating direct primary attack. The physiologic rationale of the procedure will be discussed herein following a preliminary report of two cases in which this procedure was successfully employed.

Vagotomy had been employed as early as 1946 by Mathewson[3] as an adjunct to the treatment of gastrojejunocolic fistula. In his report, preliminary ileosigmoidoscopy, as suggested by Lahey and Marshall,[2] had been performed. In one patient this was followed by vagotomy as a second stage procedure with good results. Lawton and Marks,[4] in a paper dealing with the treatment of two patients with gastrojejunocolic fistula, discussed the employment of vagotomy in the following manner. In one patient, in addition to removal of the fistula and reattachment of a new anterior gastroenterostomy, vagotomy was added without preliminary colostomy. In the other patient preliminary colostomy with restoration of continuity was followed by vagotomy eighteen months later. After careful perusal of the literature we could find no cases in which combined ascending loop colostomy and vagotomy were employed as a preliminary procedure. Second stage removal of the fistula and gastric resection were performed easily in a quiescent clean field.

CASE REPORTS

CASE 1. S. W., a fifty-two year old white man presented the following history. Twenty-five years previously he had had posterior gastroenterostomy performed for a duodenal ulcer. He remained well and asymptomatic for the next seventeen years. Eight years previously he had had an attack of epigastric pain followed by melena and hematemesis which required hospitalization. Two years later he

had a similar attack of hemorrhage and pain. One month prior to admission he had massive painless hematemesis associated with a weight loss of 16 pounds and moderately severe diarrhea.

Physical examination revealed an asthenic, moderately debilitated white man. Roentgenographic studies revealed a gastrojejunocolic fistula. At operation a moderately large fistula contained within an inflammatory mass was noted. Ascending loop colostomy and bilateral subdiaphragmatic vagotomy were performed. The postoperative course was uneventful. During the interval the patient's general health was good and the colostomy was functioning well. There was no further weight loss and no diarrhea.

Two months later a Hofmeister gastrectomy was performed with end-to-end jejunojejunostomy, and the opening in the colon was closed. At operation there was no evidence of edema or induration. The surgical area was easily identified and the surgical procedure was uneventful. Two weeks later the ascending loop colostomy was closed. During the last four-year interval the patient has done well and has gained about 15 pounds. He has no gastrointestinal complaints.

CASE II. A. H., a forty-nine year old white man, complained of diarrhea and swelling of the legs. He had ulcer type symptoms for thirty years. Twenty-seven years previously posterior gastroenterostomy had been performed; occasional bouts of gastrointestinal pain had since occurred. Three years previously following some emotional distress diarrhea developed associated with severe hypogastric pain. There was frequent belching productive of a fecal taste and odor in his mouth. This was soon followed by edema of the legs, weakness and marked weight loss.

Physical examination revealed a chronically and acutely ill patient. The liver edge was felt three fingerbreadths below the costal margin. Some edema of the feet and ankles was present.

A diagnostic survey revealed evidence of hypocalcemia (calcium, 8.4 mg. per cent) and hypoalbuminuria (total proteins, 4.5 gm., albumin, 2.1 gm.). A barium enema revealed the presence of a gastrojejunocolic fistula. At operation a marked inflammatory mass was noted which involved the site of anastomosis between the jejunum, stomach and colon. This mass was fixed, indurated and edematous. Vagotomy and right ascending loop colostomy were performed. The postoperative course was associated with some moderate diarrhea and dehydration. Diarrhea continued for two to three weeks although the patient's weight and general condition improved considerably.

Six weeks following this initial procedure, subtotal gastrectomy and end-to-end jejunojejunostomy with repair of the fistulous opening in the colon were performed. At operation the surgical field was markedly improved with only slight inflammatory changes.

Three and a half weeks later the colostomy was closed. The patient has been followed up in the Beth Israel Hospital Clinic. He has shown vast improvement with an increase in appetite and gain in weight. No diarrhea or abdominal pain is present.

COMMENTS

The procedure of ascending loop colostomy combined with vagotomy has sound physiologic application in many cases of gastrojejunocolic fistula. To attempt single stage block dissection in an indurated, edematous, contaminated mass would, in the long run, result in increased morbidity and mortality. We believe that our described procedure has merit. Long and adequate preliminary medical preparation with intravenous fluids, amino acids, albumin, plasma and blood will help to decrease mortality. The addition of modern anesthesia, antibiotics and electrolyte control has an ancillary value. Many patients with long-standing gastrojejunocolic fistula and marked systemic depletion would be unlikely to survive a single stage procedure. Such a direct attack on the fistula would be technically hazardous. It is for these patients that we are advancing our procedure.

Pfeiffer and Kent[1] first showed that regurgitation of colic contents into the jejunum and stomach were responsible for diarrhea rather than the flow of gastric contents into the jejunum and colon. Pfeiffer's preliminary colostomy stopped the diarrhea in the majority of patients by sidetracking the return of colic contents into the jejunum and stomach. The inflammatory reaction and the contaminated, indurated small bowel and stomach were allowed to heal. Since vagotomy is of proved value in the treatment of jejunal ulcers alone, it was believed that this additional procedure

would attack the jejunal ulcer directly, further decrease inflammation and aid healing. Inasmuch as the stomach, jejunum and colon are exposed at the time of initial surgery, vagotomy would require no marked additional time-consuming operative procedure. The physiologic reduction in acid and decreased gastric motility would be of great benefit in producing healing of the ulcer. Furthermore, since patients with gastrojejunocolic fistula have the most severe type of ulcer, diathetic vagotomy combined later with second stage resection of the stomach accomplishes removal of the fistula and attacks the ulcer diathesis directly.

CONCLUSIONS

1. Combined vagotomy and ascending loop colostomy is a sound physiologic approach in the first stage treatment of large gastrojejunocolic fistulas.

2. Two cases are reported in which this new procedure resulted in minimum morbidity and marked reduction of inflammatory changes around the fistula.

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Continuous Proteolytic Therapy for Decubitus Ulcers

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THE decubitus ulcer has the dubious distinction of being a rather ideal subject for the study of subnormal healing. Unlike the traumatic wound or burn which, when adequately cleansed and débrided, can be expected to repair itself by a recognized sequence of physiologic processes, the decubitus ulcer involves a constant struggle with the devitalizing forces which caused the initial breakdown. Much has been written about the importance of removing the immediate causes (pressure, trauma, maceration from incontinence) and trying to offset the underlying factors which rendered the tissues susceptible to necrosis (old age, malnutrition, neurologic and vascular deficiencies). However, since only partial success is ordinarily possible in these areas, the physician must ultimately cope with a subnormal healing process at the tissue level.

If the physician is to attack the problem of subnormal healing on a rational basis, he must try to understand what the effects are at the tissue level of the aforementioned environmental and systemic factors. In a general sense it is recognized that the local blood supply is impaired, and more particularly that oxygen and nutritive elements are subnormal; but unless a patient in the terminal stages is involved, one can assume that the physiologic elements necessary to support healing will continue to be potentially available to the tissues, although in less than ideal volume. The problem as we see it is to assure optimal nutrition to the tissues under these reduced circumstances, and the logical point of attack is to maintain the integrity of the capillary and lymphatic systems.

Miller [*1*], in an extensive review of wound healing, identified the cause of capillary blockage as the deposition of fibrin thrombi. He also pointed out that excessive fibrin escaping from dilated capillaries as a result of inflammation forms a fibrous network which prevents efficient resorption of edema fluid. He has recommended the use of fibrinolytic enzymes to maintain adequate circulation and drainage in the wound.

Barnard and co-workers [*2,3*] also found capillary blockage to be characteristic of chronic lesions, but showed the cause of plugging to be agglutinated erythrocytes. The agglutinins in these cases were tissue breakdown products (depolymerized mucoproteins, mucopolysaccharides). While acknowledging the value of proteolytic enzymes to remove necrotic tissue and debris, they pointed out that depolymerized mucoproteins were in fact the products of enzyme digestion of necrotic tissue and that ideally a proteolytic enzyme should be applied in conjunction with an antiagglutinin material (e.g., sodium copper chlorophyllin). This concept is tacitly confirmed by Miller [*1*] when he stresses the importance, when enzymes are used without an accompanying antiagglutinin, of removing the products of digestion from the wound frequently and effectively. Both groups of investigators incriminated tissue breakdown products not only as agglutinins but also as having aggressin characteristics of the nature of Menkin's [*4*] necrosin, that is, they may cause inflammation and consequent necrosis of tissue cells.

Garnes and Barnard [*3*] recently reported a study of indolent varicose ulcers which exposed a further impediment to healing at the tissue level, one which is amenable to proteolytic therapy. By microscopic sections they showed that, as a result of subnormal healing in the initial stages, a highly collagenized layer is formed over the wound base and margins which inhibits the infiltration of freshly growing

capillaries. Removal of this barrier and subsequent maintenance of healthy circulation was accomplished in this series with the same proteolytic-antiagglutinin preparation with which our report is concerned.

In our decubitus ulcer series, we had the opportunity to utilize a new topical preparation with a mode of action consistent with the requirements stated previously. It is an ointment* containing the proteolytic enzyme, papain, with urea and sodium copper chlorophyllin. Parallel studies with it have been reported by Miller [5] in decubitus ulcers and Garnes et al. [3] in varicose ulcers. Papain is a potent proteolytic and fibrinolytic agent which has no apparent effect on viable tissue [6,7]. The urea content aids protein digestion, particularly in encrusted lesions which are otherwise relatively impervious to papain. Sodium copper chlorophyllin is an established wound healing agent. While our previous experience with chlorophyllin was limited, it is pertinent to note that Pollock et al. [8], in a two-year study, found chlorophyllin ointment and liquid to be the most effective of eleven agents tested in the treatment of decubitus ulcers. It would appear that a primary value of chlorophyllin in this proteolytic ointment is as an antiagglutinin and anti-inflammatory substance, that is, it allows continuous and prolonged use of the proteolytic ingredients, papain-urea, which might otherwise cause inflammation and hemagglutination of capillaries.

Thirty patients (twenty females and ten males) with decubitus ulcers were treated with the papain-urea-chlorophyllin ointment. All were mental patients and their ages ranged from fifty to eighty years. The duration of other types of treatment of these ulcers prior to therapy with the proteolytic ointment was from one week to six months. Various methods of treatment had been used previously, but all patients had been treated with antibiotic ointments without success at some stage.

The papain-urea-chlorophyllin ointment was applied under standard dressings which were changed daily, at which time the lesion was irrigated with saline solution to remove liquefied matter.

Of the thirty patients treated, twenty-seven progressed to complete healing in from two to six weeks. Moderate to extensive necrotic tissue was present in all patients prior to this treatment and, with three exceptions, complete débridement was effected by the proteolytic ointment in from three to five days. Thereafter, the lesions remained clean and showed progressive granulation until complete epithelization was achieved.

The three failures had certain common characteristics. All were patients of approximately eighty years of age with particularly extensive necrotic involvement. The proteolytic ointment did not appear capable of achieving complete débridement by itself and it became necessary to employ extensive surgical débridement, in one patient down to the bone. Subsequent treatment with the proteolytic ointment has maintained clean lesions, but the possibilities of eventual repair do not appear encouraging.

It has not been possible to include a parallel control series, nor was it feasible to take microscopic sections to study the effect on capillary and lymphatic circulation. Nevertheless, the results obtained were so superior to any previous therapy employed here for decubitus ulcers that we must consider them significant. We attribute the superior results to the fact that the proteolytic ointment thoroughly cleansed the lesions of all necrotic tissue and debris, and then maintained optimal circulation and drainage so as to allow full availability to the tissues of such hematologic and nutritive elements as these elderly patients were able to bring to bear. It can rightfully be said that we have not demonstrated that the results were accomplished in just this manner. However, knowledge of the pharmacologic action of the individual ingredients in the proteolytic ointment supports the thesis. In addition, we can cite experience with the same preparation when each of the three ingredients was in turn omitted from it. An ointment containing papain and urea, but without chlorophyllin, proved to be a potent débriding agent but produced inflammatory reactions which necessitated its early withdrawal. Healing was not advanced by this combination. Urea and chlorophyllin ointment, without papain, was well tolerated and by ordinary standards was an effective agent for decubitus ulcers. However, its débriding action was neither as prompt nor as complete as the papain-urea-chlorophyllin ointment, and healing progressed at a slower pace. The same can be said of papain-chlorophyllin ointment, without urea. This combination was consider-

* Panafil® ointment supplied by Rystan Company, Mount Vernon, New York.

ably more effective in purulent lesions than it was in dry, encrusted lesions. This experience with the various incomplete combinations indicates that the papain and urea are essential to remove all necrotic tissue and debris, and to protect against subsequent deposition of excessive fibrin and collagen. The chlorophyllin is likewise shown to be essential to control the inflammatory products of enzymatic digestion.

SUMMARY

The physiologic elements, hematologic and nutritive, which support normal wound healing are almost inevitably in subnormal supply at the site of a decubitus ulcer. The objective of local treatment should be to assure optimal availability of this reduced supply to the tissues by maintaining the integrity of the capillary and lymphatic systems. The following factors inhibit local circulation and drainage: (1) necrotic tissue and purulent debris, (2) capillary blockage caused by fibrin thrombi or agglutinated erythrocytes, and (3) a barrier of excessive collagen frequently laid down in slow healing lesions.

An ointment combining the proteolytic agents, papain and urea, with the antiagglutinin, sodium copper chlorophyllin, provides a practical means of maintaining normal circulation and drainage in decubitus ulcers. The inflammatory effects ordinarily associated with the products of enzymatic digestion are controlled by the chlorophyllin content and continuous, prolonged use of the proteolytic ointment is thereby made possible.

A clinical trial is reported involving decubitus ulcers in thirty elderly mental patients treated with daily dressings of the papain-urea-chlorophyllin ointment. Complete healing was obtained in twenty-seven patients in from two to six weeks. The proteolytic ointment accomplished complete débridement of the ulcers in from three to five days, and thereafter the lesions remained clean with progressive granulation until healed. No evidence of irritation or sensitization was noted.

Results obtained in decubitus ulcers with the papain-urea-chlorophyllin ointment are superior to any observed by us previously in the treatment of this condition. It is our impression that continuous proteolytic therapy, as exemplified by this preparation, represents a distinct advance in the local treatment of resistant lesions.

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Intraperitoneal Administration of Terramycin in the Treatment of Generalized Peritonitis

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IN 1953 Schatten and Abbott reported the results of an experimental study on dogs in which they tested the ability of terramycin® to control peritonitis of appendiceal origin. A series of fifty-one animals was treated in one of three methods. A control group, which received no therapy, showed a 100 per cent mortality. A second group received only intravenous terramycin in therapeutic dosage, and all of the animals in this group also died. The third group was treated by instilling terramycin into the peritoneal cavity in suitable dosage. This small but significant group showed a 53 per cent survival. In addition, when the surviving animals were ultimately sacrificed, a marked reduction was found in peritoneal reaction and adhesions. These data led the authors to the conclusion that the intraperitoneal administration of terramycin was effective not only in combating the infection but also in preventing or diminishing the number and amount of adhesions after peritonitis.

In an attempt to evaluate this therapeutic measure in human patients with peritonitis we have carried out a technic of intraperitoneal administration of terramycin in a series of twenty patients at this hospital. It is the results of this study that we wish to report in this paper.

MATERIAL AND METHODS

In the eighteen months preceding this report the intraperitoneal administration of terramycin has been effected in twenty selected cases. The etiology of the peritonitis is listed in Table 1. Ten cases represent generalized infection of the peritoneal cavity secondary to perforation of the bowel wall prior to time of surgery. The other ten cases represent perforation of the bowel at time of surgery, with spillage of bowel contents to the degree that peritonitis in the postoperative period was feared by the surgeon.

TABLE 1

Etiology of Peritoneal Infection	No. of Cases
Acute appendicitis with perforation	6
Ruptured empyema of gallbladder	2
Traumatic rupture of duodenum	1
Perforated diverticulum of colon	1
Peritoneal soilage during resection of bowel	8
Peritoneal soilage during lysis of adhesions	2

Greatest attention will be paid to those cases in which there was massive contamination of the peritoneal cavity prior to surgery, since in these cases the infection was the immediate threat to life. All of the patients in this group were extremely ill from peritonitis. Their temperatures ranged from 102° to 104°F. orally. The peritonitis had existed for one to five days preoperatively. Toxemia and dehydration were the rule. All manifested obstruction, absent peristalsis and distention. Electrolyte and fluid imbalance from obstruction and vomiting was present in four cases. The preoperative diagnosis of generalized peritonitis was easily made in all cases. The ages of the patients ranged from twelve to seventy-three years. Three cases were complicated by extreme obesity, rampant diabetes

and a four and a half month pregnancy, respectively (eighteen weeks).

When diffuse peritonitis is recognized at operation and the source of bacterial contamination has been controlled, drainage of the cavity is established by a soft rubber drain or drains. A polyethylene tube of a caliber to fit snugly on an 18 gauge needle is placed alongside the rubber drain. If needed, two tubes and drains are used, for example, one to the pelvis and one to the subhepatic or cecal area. The tubes and drains are brought out through a stab wound or through the angle of incision.

TABLE II
NORMAL SIGNS AND SYMPTOMS OF RECOVERY

Signs and Symptoms	Range (No. of Days)	Average Days
Peristalsis became audible	1 to 5	2.7
Passage of flatus	1 to 5	3.3
Passage of bowel movement	3 to 7	5.5
Food retained by mouth	1 to 6	3.9
General diet taken	4 to 13	8.5
Temperature reached normal	2 to 12	3.4
Temperature stayed below normal	2 to 12	5.4

To the tube or tubes is connected a bottle of 500 cc. of normal saline containing 500 mg. of terramycin. If two tubes are used, one bottle is connected to both tubes by a Y adapter. The solution is allowed to run into the peritoneal cavity at a rate of 8 to 12 drops per minute around the clock. Usually eight hours are sufficient to introduce 500 cc. of the solution. Administration is continued for three to five days, averaging three and a half days in this series. Duration of treatment is determined by improvement of the patient as evidenced by the return of peristalsis, passage of flatus or of a bowel movement, drop in temperature and pulse to normal, or other signs indicating recovery.

Achromycin® has been used in two cases with similar response. Aureomycin was found by Schatten and Abbott to cause peritoneal reaction and has not been used in this series for that reason. By error it was given to one patient for eight hours; however, there was no ill effect.

Drainage from the wound varies. Sometimes the drainage is scant but it is usually profuse and becomes watery after twenty-four hours. The amount of drainage in all cases is less than the amount of administered solution, signifying peritoneal absorption of the solution. When the amount of drainage is so profuse as to approach the administered amount, we believe this represents a walling-off of the irrigated site with resultant impairment of general spread through the peritoneal cavity.

Dressings are not changed for twenty-four hours in the hope that saturated dressings will exert a local bactericidal effect in the region of the skin wound.

By forty-eight hours the antibiotic sensitivity of the offending organisms has been determined by the laboratory. Thus far we have not encountered organisms that are resistant to terramycin, although this will no doubt arise in the future when the bacterial population has been more exposed to this antibiotic. The organisms have been identified in each case by culture from the peritoneal cavity at time of operation, and have uniformly been Escherichia coli, anaerobic streptococci, both hemolytic and non-hemolytic, unidentified micrococci, and in several cases gram-negative bacilli; as stated, all have been susceptible *in vitro* to terramycin.

Concomitantly, parenteral terramycin has been given in doses of 250 mg. every six hours. In two cases we have relied solely upon the intraperitoneal route of administration, with a satisfactory outcome in both cases.

UNTOWARD REACTIONS

The intraperitoneal administration of the antibiotic solution causes the patient little or no distress. A twelve year old boy complained of abdominal pain during the administration. This pain was relieved by slowing the rate of infusion. A seventy-three year old woman complained of subcostal pain during administration and was later found to have a subphrenic abscess. Although all patients had nasointestinal tubes for decompression, four patients had recurrent distention. However, this condition was marked in only two cases. It was the impression of several observers that the course of these patients was rather bland considering the proved extent of the peritoneal infection.

RESULTS OF TREATMENT

The manner in which the patients responded to this type of treatment is best shown in Table II.

Of the twenty patients thus treated, only

one showed delayed response to the therapeutic regimen. In this patient a subphrenic abscess developed which caused slight fluctuations in temperature for almost two weeks before returning permanently to normal. The patient had irrigations for four days, but after cessation of irrigation she began to show signs and symptoms of a collection of pus under the liver. This condition responded to continued parenteral terramycin therapy.

All of the ten patients with peritonitis survived. Two patients required secondary closure of the abdominal wound. Of the ten patients with peritoneal soilage incurred during surgery, one died. These three cases are mentioned in detail because they are the only ones in which the patients did not respond in full measure to the treatment.

CASE REPORTS

Case I. A markedly obese seventy-three year old woman was admitted with peritonitis of four days' duration. Laparotomy revealed generalized peritonitis secondary to a ruptured appendix. Parenteral and intraperitoneal terramycin was given as outlined above. Irrigation was continued for four days. Because of profuse watery drainage it was thought that the irrigated site was walled off and general irrigation of the peritoneal cavity was not being accomplished. The wound partially separated on the eighth postoperative day, after three days of coughing due to subphrenic collection of pus. Secondary closure was effected and patient recovered without complication. Parenteral terramycin was used to control the subphrenic abscess, which did not require surgical drainage.

Case II. A thirty-three year old man was admitted with abdominal injuries received in an automobile accident. Four days after the accident he underwent laparotomy, and generalized peritonitis secondary to complete rupture of the duodenojejunal junction was found. Intraperitoneal and parenteral terramycin was given in the usual manner. On the tenth postoperative day the lower angle of the incision began to exude serosanguineous fluid and a separation of the entire thickness of the wound for a distance of 2 inches was noted. Secondary closure resulted in an uncomplicated recovery. In this case, also, the profuse watery drainage from the wound suggested impaired circulation of the antibiotic solution in the abdominal cavity.

Case III. A seventy-four year old woman was admitted with a "napkin-ring" carcinoma of the rectosigmoid junction. Laparotomy revealed a huge fibroid uterus which had to be removed by hysterectomy before anterior resection of the tumor could be performed. This woman also had diabetes which was extremely difficult to control, although this may not have played any role in her subsequent course. She fell from bed on her fourth postoperative day. Intraperitoneal administration of terramycin was utilized because there was massive contamination of the peritoneal cavity when bowel clamps slipped during the operation. On the tenth day the wound started to disrupt and secondary closure was effected. On the fourteenth day a fecal fistula appeared at the lower angle of the incision. The patient began to suffer pulmonary emboli on the fourteenth day, and after three days of anuria secondary to a severe transfusion reaction she died from her third pulmonary embolus.

COMMENTS

Because of the three wound separations occurring in twenty cases in which terramycin was administered intraperitoneally, it might appear that there is some inhibition of fibroplasia by the constant bathing of the wound with the solution. In two of the three cases in which there was dehiscence drainage was via stab wound, yet the separation occurred in the incision. In two cases the drainage from the wound during active irrigation was so profuse as compared with the other cases that it was believed the walling-off action of the omentum and loops of bowel was restricting the area of exposure to the terramycin solution. In these two cases, however, there were multiple stringy adhesions throughout the peritoneal cavity discovered at time of secondary closure. This is in contrast to the case of a twelve year old boy who had responded excellently to the regimen. The peritoneal cavity of this patient was re-explored four months later. Only one thin adhesive band was found in the entire cavity and that was from the remnant of his originally ruptured appendix to the omentum. It was pointed out by Schatten and Abbott that their surviving dogs showed a similar diminution in number of adhesions. Whether or

not the inhibition of adhesions is due to some antifibroplastic action of the technic, which is also responsible for failure of wound healing in the three cited cases, must await further study.

Although personalities play little part in such a study, we believe the reader may gain some idea of the confidence we have in the technic by mention of the use of this method by two surgeons on members of their families. Both patients responded in full measure of success, one of whom was four and a half months pregnant at the time of her appendiceal peritonitis.

SUMMARY

A series of twenty cases is presented in this preliminary report in which the intraperitoneal administration of terramycin has been used in the treatment of peritonitis. An analysis of these cases has led us to the impression that it is a useful adjunct in the over-all therapy of this disease.

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Effect of Pronestyl on Experimental Coronary Occlusion in Hypothermic Dogs

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The frequency of cardiac arrhythmias is prominent among the difficulties encountered with hypothermic technics. The prevention and treatment of this complication has been extensively studied. Swan and coworkers [1] observed that adequate spontaneous respirations ceased during hypothermia and that forced ventilation aided in the prevention of fibrillation. They also noted the fall in serum potassium during cooling and suggested the use of a potassium solution as an adjunct in defibrillation. Riberi et al. [2] demonstrated the prophylactic benefit of procaine infiltration of the right atrial wall combined with the use of arfonad.® Sympathetic block and vagal stimulation appeared to be valuable in reducing the incidence of ventricular fibrillation when hypothermic dogs were subjected to venous inflow occlusion and right ventriculotomy.

The deleterious effect of hypothermia on the survival of dogs with acute myocardial infarction was noted by Selman and Brofman [3]. Fifty per cent of their normothermic dogs survived ligation of the anterior descending coronary artery, whereas all hypothermic animals died almost immediately from ventricular fibrillation following experimental coronary occlusion.

In a previous study, Davis et al. [4] believed that they were able to demonstrate some prophylactic protection with pronestyl® in experimental coronary occlusion in dogs. Instead of the expected 50 per cent mortality from ligation of the anterior descending branch of the left coronary artery, twenty-nine of thirty animals survived the procedure. All of these dogs had been given pronestyl parenterally before surgery.

The possibility that pronestyl might have some protective value during the hypothermic state seemed worthy of investigation. Would there be any survivors if coronary occlusion were created in hypothermic animals (dogs) treated preoperatively with pronestyl?

METHOD

Twelve dogs were anesthetized with sodium nembutal® (27 mg./kg.). The animals were given 2 to 3 cc. of pronestyl intravenously or intramuscularly twenty to thirty minutes before placement in ice. Hypothermia was achieved by an ice-water bath and rectal temperatures were recorded. The animals were removed from the bath at temperatures varying between 28 and 32°C.

The dogs were placed on a special stand to maintain a uniform, standard position both for surgery and electrocardiographic purposes. Forced ventilation with room air was then mechanically produced via an endotracheal tube. A left, fifth interspace thoracotomy incision was employed. After incising the pericardium anterior to the phrenic nerve, two ligatures were tied around the anterior descending branch of the left coronary artery at the highest exposed area below the auricle. No attempt was made to dissect the junction of the circumflex and anterior descending coronary artery. In many instances the entire coronary vascular bundle was ligated because of troublesome bleeding from the accompanying coronary veins. Electrocardiographic recordings were taken at intervals with extremity leads. Survivors were studied with chest leads as well, and were given penicillin and pro-

TABLE I

EFFECT OF PRONESTYL ON EXPERIMENTAL CORONARY OCCLUSION IN HYPOTHERMIC DOGS

Weight (lb.)	Pronestyl Dosage (mg./lb.)	Lowest Temperature (°c.)	Operation	Results
53.5	3.73	31.5	Ligation	Fibrillation 5 min. after ligation
47.5	4.2	27.0	None	Died 20 min. after removal from ice bath
23.0	13.0	30.0	Ligation	Sacrificed 14 days postoperatively
65.0	4.6	28.0	Ligation	Ventricular fibrillation 10 min. after ligation
71.0	4.2	27.0	Pericardium opened	Ventricular fibrillation during manipulation
31.0	9.7	24.5	None	Died 15 min. after removal from ice bath
32.0	9.4	25.0	Ligation	Ventricular fibrillation 4 min. after ligation
37.0	8.1	30.0	Ligation	Sacrificed at 14 days
30.0	10.0	28.0	Ligation	Died 20 min. after surgery; pneumothorax (?), fibrillation (?) (died in warming blanket)
19.0	15.7	28.0	Ligation	Sacrificed at 14 days
56.0	5.4	27.0	Pericardium manipulated	Ventricular fibrillation during pericardial manipulation
64.5	3.1	28.5	Pericardium manipulated	Ventricular fibrillation during pericardial manipulation

nestyl daily. They were sacrificied for study on the fourteenth day.

RESULTS

No immediate untoward reactions were observed from the nembutal anesthesia or the preoperative pronestyl. The full anesthetic dose of nembutal seemed to be required for contact with the ice-water bath. Thirty to fifty minutes were required to bring the rectal temperatures to 30°c., and temperatures continued to fall for thirty to forty minutes after the animals were removed from the ice bath. The rate and depth of respiration decreased. The pulse rate slowed. All animals survived the immersion period. Two dogs, however, died shortly thereafter and were not operated upon. A temperature of 27°c. developed in one dog; the other had a temperature of 24.5°c. Of the remaining animals, ventricular fibrillation developed in four within minutes of the coronary artery ligation, and three went into ventricular fibrillation on manipulation of the heart. Extrasystoles usually preceded the fibrillation. When a fatal arrhythmia followed the ligation, it occurred at four minutes, five minutes and ten minutes, respectively. In one instance electrocardiographic evidence of spontaneous coronary occlusion and subsequent fibrillation preceded an attempt at ligation.

No animal that reached a temperature of 27°c. or less survived the operative procedure, and survival was shortest at the coldest levels. The three animals that lived until sacrificed on the fourteenth day reached hypothermic temperatures of 28°c., 30°c. and 31°c., respectively.

COMMENTS

Pronestyl hydrochloride is the amide analogous to procaine hydrochloride. Its advantages over procaine for arrhythmias are as follows: (1) less toxicity both in the anesthetized and unanesthetized patient; (2) greater stability and prolonged action as it is little affected by procaine esterase; and (3) effective use both orally and parenterally. The action of pronestyl appears to be a direct depressant on the ventricular muscle.

Clinical investigators have demonstrated great effectiveness in the treatment of ventricular arrhythmias. Pronestyl has proved effective during arrhythmias in diminishing the high incidence of ventricular extrasystoles and ventricular tachycardia associated with thoracic surgery, particularly when cyclopropane has been used [5]. Hypotension may occur following intravenous administration of the drug to a conscious patient. Intramuscular injection is free of this occasional complication.

Dogs are notoriously poor candidates for coronary occlusion studies because of their rich collateral circulation about the myocardium. Nevertheless, the extensive accumulation of data on canine coronary occlusion work gives a precedent for expected results. Most researchers would anticipate a 50 per cent immediate mortality. Age, size, sex and kind of dog do not

seem to be the important considerations. With combined hypothermia and coronary occlusion, a 100 per cent immediate mortality would be apparent if no other protective measures were taken [3].

In this study no attempt was made to employ any of the various suggested measures to prevent ventricular fibrillation, with the exception of prophylactic pronestyl. No mechanical breathing device was used during the cooling period; potassium chloride and arfonad were not administered.

Although a diminished anesthesia requirement in the hypothermic state would be predicted, the full dosage of nembutal seemed necessary to control the stimulation of contact with the ice bath. Perhaps a gradual temperature gradient or a longer anesthesia-to-ice waiting period would have diminished the nembutal requirement. Profound depth of anesthesia was apparent later at the time of intubation and thoracotomy.

Of particular note was the sizable dosage of pronestyl in the survivors. No dog lived unless an amount in excess of 8 mg. per pound was used. (Table 1.) The two animals with the highest dosage, 13.0 mg. per pound and 15.7 mg. per pound, lived for the full fourteen-day observation period.

The relative depth of hypothermia would also appear to have significance from this work. Those animals that were taken to the lowest temperatures did least well. Two of these died despite what would appear to have been an adequate protective dose of pronestyl. These dogs reached temperatures of 24.5°C. and 25°C., respectively. (Fig. 1.)

Regrettably, there are differences in the several series of dogs compared in this study. Selman and Brofman employed forced pneophore ventilation with oxygen during the cooling phase and thereby gave their dogs some protection against fibrillation. Our animals were not intubated until after they were removed from the ice. Room air was used with a homemade mechanical respirator in our group. A pneophore was not available. Furthermore, an attempt was made to duplicate the anesthesia and the surgical technics which had previously been employed on our normothermic animals [4].

Another difference was the size of the animal used. The average animal in our hypothermic series was considerably heavier than that employed in our normothermic and Selman and Brofman's hypothermic series. Consequently, the pronestyl dosage per pound averaged somewhat less in our hypothermic animals. Blood levels of pronestyl may also have been affected when given intramuscularly due to diminished absorption from external cold.

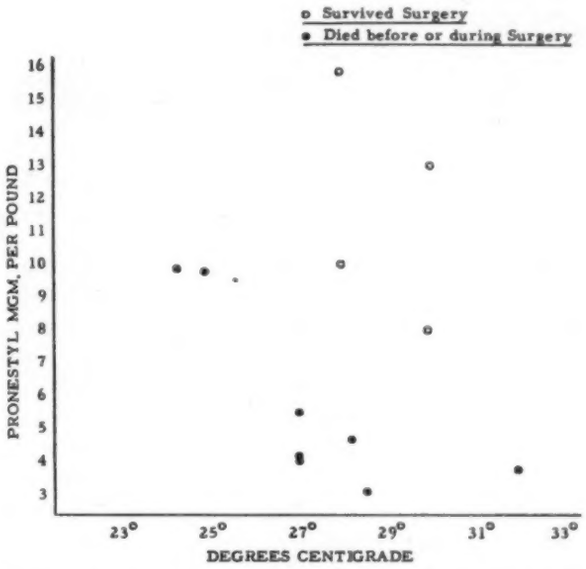

FIG. 1. Effect of pronestyl dosage and temperature on survival.

Despite other unknown factors such as sex, breed of animal, age of animal and nutritional status, it is believed that the several survivors may have benefited from prophylactic pronestyl during experimental coronary occlusion in the hypothermic state. Further studies are contemplated in which pronestyl will be combined with other measures to further decrease the incidence of ventricular arrhythmias in hypothermia.

SUMMARY

1. This study confirms the deleterious effects of hypothermia on experimental coronary occlusion in dogs.

2. Pronestyl in large doses would appear to give some protection against ventricular fibrillation in hypothermic dogs with ligation of the anterior descending branch of the left coronary artery.

3. Pronestyl in moderate amounts does not prevent fatal arrhythmias if temperatures below 28°C. are achieved.

4. Prophylactic pronestyl may have a place in clinical hypothermic states and in some

patients with acute myocardial infaraction in order to decrease the incidence of ventricular arrhythmias.

Acknowledgment: We are grateful to C. C. Ashley, Mark Wynn, R. F. Menendez, A. A. B. Johnston and E. V. Domutz for their technical assistance.

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Acute Pneumocholecystitis

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ALTHOUGH acute pneumocholecystitis is an uncommon condition, it does present all the symptoms and signs of acute abdominal disease. Acute pneumocholecystitis signifies the production of gas within an acutely inflamed gallbladder. The clinical diagnosis of the acute process is usually made without difficulty, however the presence of gas can be detected only by x-ray examination. Air can be seen within the gallbladder with a fluid level early in the disease; however, as the pathologic condition progresses, pericholecystic collections of gas can be seen because of necrosis and perforation of the wall of the gallbladder and the escape of gas into the surrounding tissue or abscess cavity. Pyopneumocholecystitis is the term applied to cases in which both pus and gas are present. The name emphysematous cholecystitis has been used by Schmidt [*1*] and Stevenson [*2*] to describe this condition. However, since perforation does not always occur, gas does not infiltrate into the pericholecystic tissue in all cases; therefore the term is not as acceptable as pneumocholecystitis.

Welch and Flexner [*3*] in 1896 were the first to report the presence of gas in the gallbladder at autopsy. In 1908 Lobingier [*4*] and in 1922 Tanner [*5*] reported the same findings at autopsy. Whether or not these findings were the result of postmortem changes could not be ascertained. In 1923 Brütt [*6*] described the presence of gas in the gallbladder at operation; however, Kirchmayr [*7*] was the first to be credited with this finding which he reported in 1925. He described the condition as one of a gangrenous gallbladder distended with gas and pus from which gas had escaped into the peritoneal cavity through a perforation. In 1931 Hegner [*8*] reported the first case which had been diagnosed preoperatively by means of roentgenography. Del Campo and Otero [*9*] reported one of the few cases of emphysematous cholecystitis that was proved to be due to Bacillus welchii.

In 1948 Heifetz and Senturia [*10*] in a review of the literature found only eight *bona fide* cases and added two of their own. Culver and Kline [*11*], also in 1948, reported the observation on radiography of a gas-filled gallbladder with diffusion of gas into the wall of the gallbladder.

In 1952 Abel and Rousselot [*12*] reported the only other case of pneumocholecystitis at St. Vincent's Hospital, New York City in which a successful result had been achieved by operation. In 1955 Friedman et al. [*13*] found Clostridium perfringens in the culture of only one of the operative cases.

Only about twenty-five cases have been reported in the literature to date. The report of new cases will make the profession cognizant of the entity and perhaps reduce the mortality rate of 20 per cent, since it will be noted that procrastination in the management of these patients can only result in complications which in turn are responsible for mortality.

The type of bacteria found is of particular interest. While the welchii bacillus would appear to be the most common offending organism, it is not usually found in cultures taken at operation. Gas-forming bacilli are common inhabitants of the biliary system and are not unlike those present in the intestine. While many normal and diseased gallbladders are sterile, others reveal the presence of a wide variety of bacteria. The most common organ-

isms present are Escherichia coli communis and the Clostridium perfringens; however, other gas-forming organisms do exist. Anaerobic streptococcus has been reported as a fairly constant inhabitant and the one which has been most frequently found in the reported cases. Staphylococcus aureus hemolyticus (anaerobic and facultative) was found in the case herein reported. Many of the gas-producing organisms therefore obviously exist in the biliary system as harmless saprophytes but, under certain conditions, may become pathogenic.

The factors responsible for the pathogenesis of acute cholecystitis in these cases are the same as for the usual acute gallbladder. In most cases there is an obstruction in the cystic duct due to the incarceration of a calculus, followed by ischemia due to circulatory embarrassment; a chemical inflammatory reaction of the gallbladder then ensues. Approximately four days later, if the process is progressive, bacterial invasion is superimposed on the already devitalized gallbladder and the acute infective process becomes established. At this stage medical treatment is effective in a large percentage of cases. However, if a true emphysematous lesion develops, the pathologic condition is somewhat altered. It is for this reason that treatment should be more radical; surgical intervention is almost mandatory if the outcome is to be favorable. In the emphysematous acute gallbladder the offending organism is usually virulent in character, and with the production of gas there is further distention of an already devitalized organ, resulting in necrosis of its wall, perforation and extension of the infection into the surrounding tissue, forming an abscess in many cases. The abscess may remain localized or extend into other parts of the abdomen resulting in extensive infection or even generalized peritonitis.

DIAGNOSIS

Acute cholecystitis can usually be diagnosed; however, the diagnosis of pneumocholecystitis can only be made by roentgenography. The use of scout films cannot be overemphasized in suspected cases. The x-ray findings are characteristic. A sharply outlined gas shadow with a fluid level, either round in shape or conforming to the size and shape of the gallbladder, is seen in the right upper quadrant. With the progression of disease, gas may be seen in the planes of the wall of the gallbladder and later in the surrounding pericholecystic area. No gas is noted in the bile duct system.

The diagnostic criteria for this condition published by McCorkle and Fong should be satisfied before positive diagnosis can be made. These criteria are as follows: (1) Gas is confined to the lumen of the gallbladder. (2) A fluid level is present in the upright film. (3) There is no visualization of gas in the bile duct system. (4) Gas is present within the wall of the gallbladder.

Other conditions that reveal the presence of gas in the gallbladder or bile duct system are: (1) an abnormal spontaneous communication between the gallbladder or bile ducts and the digestive system, such as a fistula between the gallbladder or bile ducts and the stomach, duodenum or colon; (2) operative procedures producing a communication between the gallbladder or bile ducts and digestive tract such as cholecystogastrostomy, cholecystoduodenostomy or jejunostomy or an anastomosis between the common duct and duodenum or jejunum; and (3) incompetent sphincter of Oddi either due to disease or due to operation (sphincterotomy) causing reflux of gas into the duct system.

TREATMENT

A review of the literature reveals a division of opinion as to the method of treatment most suitable for this condition. Some believe the treatment should be conservative, utilizing penicillin and other antibiotics, sulfonamides, polyvalent gas antiserum and x-ray therapy. Others advocate surgery as the method of choice. With a positive preoperative diagnosis, considering the pathologic condition described and the progression of the disease, it seems to me that surgical intervention is almost mandatory if one is to avoid a fatality.

The type of surgery is of importance. In these cases, more than in the ordinary case of acute cholecystitis, one has to be most discrete in exercising surgical judgment, for in the majority of cases in which the condition has progressed to the point of extravasation of air in the surrounding tissue, the wall of the gallbladder will have degenerated to a degree that would make cholecystectomy impossible. In this instance simple drainage is the only logical and safe procedure. It should be performed with the least amount of exploration since the latter is only for the satisfaction of one's

FIG. 1. Globular mass in right upper quadrant of scout film is an early finding on x-ray examination. Note fluid level.

FIG. 2. X-ray of abdomen four days later than Figure 1, showing gas in the wall of the gallbladder and in the pericholecystic area.

scientific curiosity and possibly can result in a fatal outcome.

CASE REPORT

H. G., a fifty-seven year old white man, was admitted to St. Vincent's Hospital, New York City, August 29, 1955, with a complaint of pain in the right upper quadrant associated with abdominal distention, vomiting and fever of four days' duration. Four days prior to admission the patient stated that he had injured his right upper quadrant while working. There was no history of any previous similar episodes nor of any disturbance of his digestion at any time. The significant findings on admission were tenderness and spasm in the right upper quadrant with the sensation of the presence of a mass. The abdomen was moderately distended. The temperature was 102°F. and the white blood cell count was 29,300 per cu. mm. with 93 per cent polymorphonuclear leukocytes. The red blood cell count was within normal limits. With the use of achromycin® the white blood cell count and the temperature decreased steadily and the spasm and rigidity of the right upper quadrant were practically absent by the tenth day. However, on the eleventh day the count began to rise again to 11,400 per cu. mm. and a slightly tender swelling appeared just below the right costal margin.

X-ray examinations were made on admission August 30, 1955. The scout film revealed the presence of an ileus and a globular mass 5 cm. in diameter with a fluid level, overlying the lower portion of the right lobe of the liver. (Fig. 1.)

Repeat x-ray examination (Gallbladder Series: September 3, 1955) revealed the absence of dye in the gallbladder. The previously described globular shadow now assumed the typical outline of a gallbladder with evidence of gas in the wall of the gallbladder and in the pericholecystic area. There was no gas in the intrahepatic portions of the biliary system. (Fig. 2.)

The preoperative diagnosis was acute pneumocholecystitis and operation was performed on September 9, 1955, through a subcostal incision. Numerous omental adhesions to the parietal peritoneum, liver and gallbladder were noted. On freeing the omentum from the anterior lower surface of the right lobe of the liver, purulent fluid and air under pressure

were evacuated through a necrotic area in the liver. As the omentum was peeled off the fundus of the gallbladder, air and pus were again evacuated. The wall of the gallbladder was so degenerated that it was gelatinous in character. There was a very large subhepatic abscess which obviously was secondary to the perforated gallbladder. The fundus of the gallbladder was opened, numerous small calculi were removed, and a free flow of bile was obtained. A tube was placed in the gallbladder, drains were inserted into the subhepatic abscess, and the abdomen was closed without further manipulation.

The pathologic report was as follows: Subacute inflammation of tissue (wall of gallbladder); cholelithiasis; and culture of Staphylococcus aureus hemolyticus, a facultative anaerobe.

The postoperative course was uneventful. The achromycin medication was continued and the patient was discharged on the twenty-fifth postoperative day with no complaints and the wound well healed.

COMMENTS

In the case herein reported although the diagnosis of acute cholecystis was entertained, the history of injury had to be considered. The possibility of a subcapsular hematoma of the liver with infection or a posteriorly perforated duodenum were considered, however, with the findings on the scout film the diagnosis became apparent. Operation had been deferred for ten days since it was thought that this was the optimum time when the infection would be under control. This obviously was not true because of the findings at operation. The condition was progressing in spite of intense antibiotic therapy and supportive measures. In view of the tendency for these infections to spread under the best conservative management it seems that the procedure of choice is surgical intervention as soon as the diagnosis of acute pneumocholecystitis has been made. One should not wait for the stage of pericholecystic infiltration of gas because serious complications will have developed by that time and the patient will be in jeopardy.

SUMMARY

1. A case of acute pyopneumocholecystitis which was diagnosed preoperatively with the aid of a scout film has been reported.

2. A review of the literature has been presented.

3. Surgical therapy was instituted in the case herein reported with uneventful recovery.

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Intussusception in an Infant Due to Leiomyosarcoma of the Jejunum

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A RECENT case of intestinal obstruction due to intussusception secondary to leiomyosarcoma of the jejunum has led us to review the literature on this subject.

Although an exceedingly rare neoplasm, leiomyosarcoma of the jejunum merits consideration as a malignancy which offers a good hope for cure when treated by radical surgery in its early stages. This malignant disease is characterized by an insidious onset, and at first its clinical manifestations are vague and only mildly disturbing. More obvious obstructive and hemorrhagic phenomena occur when the neoplasm spreads to involve the intestinal lumen and generally indicates a late stage in the disease. Because leiomyosarcoma of the jejunum is slow to metastasize, however, even a palpable abdominal mass does not mean that the growth is inoperable, and tumors of relative long-standing may be salvaged by radical surgery [*12*].

CASE REPORT

M. S., a seven month old white male infant, was admitted to the hospital on December 10, 1954, with a two-week history of occasional episodes of postprandial vomiting, projectile in nature. There had been no bowel movements for the three days prior to admission. The infant had been treated for an upper respiratory infection by the family physician for the previous two weeks. There was no history of melena or hematemesis.

Examination on admission revealed a well developed, moderately hydrated white male infant with a rectal temperature of 100°F. The abdomen was soft and non-tender. Aside from a dilated descending colon, no other masses or organs were palpable. Rectal examination revealed normal sphincter tone with a palpable fecal mass at the finger tip. There was no blood on the glove finger.

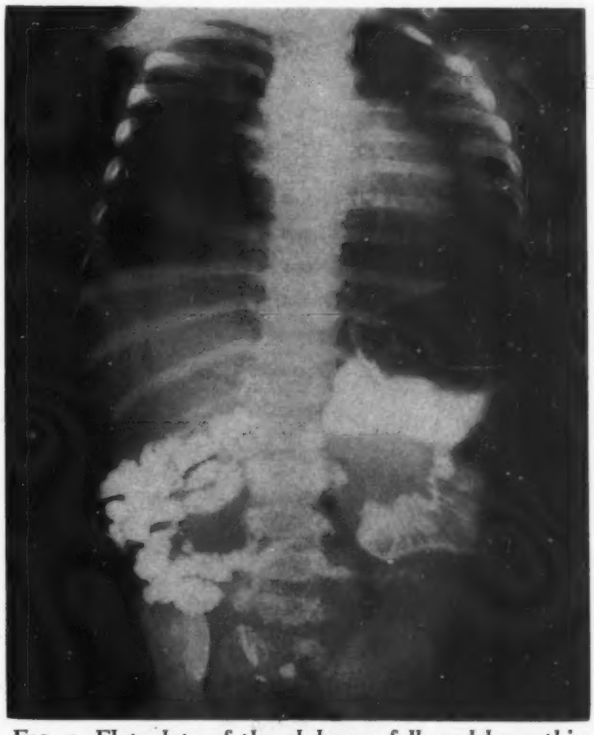

FIG. 1. Flat plate of the abdomen followed by a thin barium swallow revealed an incompletely obstructing lesion at the proximal jejunum, the precise nature of which was indeterminate, but suggestive of an intraluminal lesion.

Laboratory examination revealed a red blood cell count of 4.3 million with a hemoglobin of 67 per cent; white blood cell count was 10,300 with a differential displaying a shift to the left. Urine revealed a normal specific gravity with a 2 plus sugar and acetone. No cells were seen. Carbon dioxide combining power was

FIG. 2. Anteroposterior view of segment of jejunum demonstrating attached tumor nodule measuring 2.5 cm. in diameter.

32 volumes per cent; sodium, 128 mEq./L; potassium, 3.5 mEq./L; chloride, 500 mEq./L. Flat plate of the abdomen (Fig. 1) followed by a thin barium swallow under the constant attendance of both the roentgenologist and pediatrician revealed an incompletely constructing lesion at the proximal jejunum, the precise nature of which was indeterminate, but suggestive of an intraluminal lesion.

A surgical consultation followed and examination at this time revealed a soft abdomen with a mobile tense "horseshoe"-shaped mass occupying the left upper and middle quadrants. In view of the history, physical and x-ray findings, immediate intubation followed by laparotomy was advised.

Exploratory laparotomy was performed and a high jejunal obstruction due to a jejunojejunal intussusception about 6 inches from the ligament of Treitz was found. The leading point was a polypoid tumor mass approximately 2.5 cm. in diameter. There was free fluid in the peritoneal cavity. Several of the regional lymph nodes were enlarged and inflammatory in appearance. Block resection of the neoplasm along with its mesentery and contained lymphatics was performed with end-to-end anastomosis to re-establish the continuity of the intestine.

FIG. 3. Lateral view of segment of jejunum demonstrating attached tumor nodule measuring 2.5 cm. in diameter.

The pathologic report revealed the following data: Specimen consisted of a segment of jejunum measuring 8.5 cm. in length. Attached to the mucosa .5 cm. from the proximal line of resection was a tumor nodule 2.5 cm. in diameter. Its outer surface was greenish yellow and corrugated. On cut section it was yellow-gray and firm with focal hemorrhagic areas. The lumen proximal to the lesion was dilated and the mucosa was edematous. The serosa was gray-white, smooth and shiny. The largest of the lymph nodes received measured 1.5 by 1 by 1.5 cm. The outer surface was gray-white, smooth and shiny. On cut section it was a homogeneous brownish gray. (Figs. 2 to 4.)

Microscopically, the tumor was composed of interlacing elongated cells which were separated in areas by a vacuolated ground substance. There was extensive necrosis and inflammation of the mucosal surface. Many of the cells showed large, somewhat typical nuclei and a fair amount of mitotic figures was present. The adjacent jejunum showed chronic inflammation. The lymph nodes showed only hyperplasia. (Fig. 5.)

The diagnosis was leiomyosarcoma of the jejunum.

The hospital course was uneventful except for mild phlebitis which developed four days postoperatively at the site of the cutdown. Surgery was supplemented by active fluid and electrolyte therapy. With the return of active peristalsis on the third postoperative day, the Levin tube was removed and oral feedings were begun. Subsequent chemistries were within

FIG. 4. Cut section of the tumor nodule revealing a yellow-gray color with focal hemorrhagic areas. The lumen of the bowel proximal to the lesion is dilated and the mucosa is edematous.

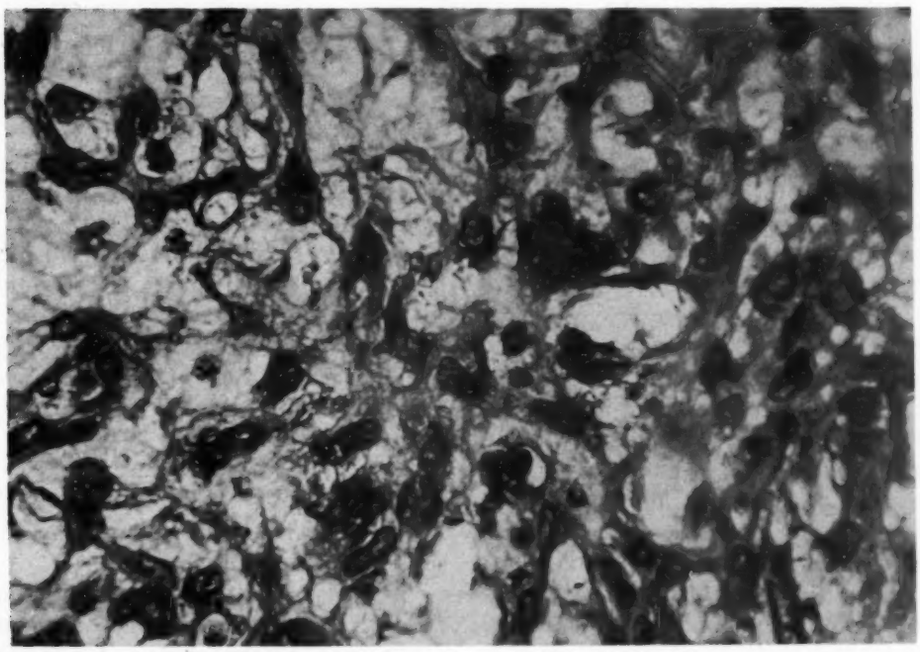

FIG. 5. Microscopic sections showing interlacing bundles of small muscle cells with marked cellular atypism and nuclear hypochromasia.

normal limits and the infant was discharged on the tenth postoperative day with primary union of the wound. The nine-month follow-up of this patient revealed a progressive weight gain and absence of symptoms.

OBSERVATIONS

Leiomyosarcoma of the jejunum appears to be a distinct clinical and pathologic entity. To the best of our knowledge, leiomyosarcoma of the jejunum with subsequent intussusception in a seven month old child has not been reported to date.

Incidence. Cancer of the small intestine is one of the more rarely encountered surgical problems. Raiford states that these tumors compose only 4.9 per cent of the malignancies found in the gastrointestinal tract, while Ewing

cites Brill's low figure of 2.5 per cent. In an extensive survey, Shallow et al. found these tumors to be represented in 0.1 per cent of general autopsies. Leiomyosarcoma of the jejunum is very uncommon. Anderson and Doob found that only ten of these tumors had been reported from 1875 to 1933 [1]. Of 108 patients with small bowel malignancies treated at the Mayo clinic from 1907 to 1939, only two had leiomyosarcoma of the jejunum. Single cases have been reported more recently by Rankin in 1943, Collins and Spencer in 1947 [4], Dixon and Kratzer in 1951 [5], and Flemming and Pearson in 1951 [6]. Marshall and Cherry of the Lahey Clinic have recently reported three additional cases of leiomyosarcoma of the jejunum. Gross [8] states that he has not encountered a single case of leiomyosarcoma of the jejunum with subsequent intussusception in infancy at the Children's Hospital in Boston.

Clinical Features. Tumors of the small intestine usually manifest themselves so insidiously that in their early formative stage they may mimic less severe gastrointestinal diseases. In most instances the patients present themselves with signs and symptoms of partial or complete obstruction of several days' or weeks' duration. With high-placed tumors, vomiting occurs quite early. The vomitus usually contains blood, free hydrochloric acid and gastric enzymes. Massive hemorrhage is not frequent although the stool usually contains occult blood. The more proximal the tumor, the earlier the gastrointestinal symptoms occur. Changes in bowel habits are common, occurring usually as increasing constipation and diarrhea. Often the clinical picture is that of a secondary anemia but is diagnosed as pernicious anemia and treated unsuccessfully as such.

Severe intermittent pain, increasing nausea, vomiting and distention, and the classic symptoms and signs of intestinal obstruction become more evident as the disease progresses from partial to complete obstruction. As a result of the loss of fluid in the vomitus and into the distended bowel, there is a fall in the blood chlorides, a rise in the non-protein nitrogen, and some degree of alkalosis, dehydration and prostration. These findings become irreversible unless the obstruction is relieved and the fluid and electrolyte imbalance adjusted.

Pridgen et al. of the Mayo Clinic reported that 70 per cent of patients with jejunal lesions demonstrated some degree of either partial or complete obstruction of the small bowel [12]. They noted a palpable mass in 41 per cent of the cases in the jejunum and 48 per cent of the cases in the ileum. The left lower quadrant was usually the site of the mass when located in the jejunum, while it would occupy the right lower quadrant when located in the ileum. In 30 per cent of the patients with obstructive lesions, visible peristalsis was present. Borborygmus was present in approximately 50 per cent. About 25 per cent of the patients complained of excessive flatus or belching gas.

Treatment. The treatment of patients with tumors or malignancies of the small intestine depends upon the individual disease present. Fluid and electrolyte balance must be corrected and decompression initiated in all patients presenting obstructive symptoms. In cases of evident anemia, transfusion of whole blood is usually necessary. Radical resection of the affected portion of intestine with its related mesentery and lymphatics is the treatment of choice when one is confronted with cases of malignancies of the small bowel. Whenever possible, end-to-end anastomosis should be performed in the restoration of continuity of the small intestine. Even in the presence of distant metastasis, radical resection is justified in patients in whom relief from pain, hemorrhage or obstruction may be obtained through this palliative procedure.

SUMMARY AND CONCLUSIONS

1. A brief review of malignancies of the small bowel is presented.

2. Early symptoms such as abdominal pain, weight loss, anemia and vomiting should make one aware of possible disease in the small bowel. This should be confirmed by roentgenologic study.

3. The absolute indications for laparotomy are hemorrhage, obstruction or the presence of an abdominal mass.

4. Early definitive surgery will offer a better prognosis in regard to the morbidity and mortality associated with malignancies of the small intestine. Early surgery is mandatory in all cases of obstruction in infants and children.

5. The procedure of choice in malignancies of the small bowel is radical block resection of the neoplasm along with its mesentery and contained lymphatics.

6. Leiomyosarcoma of the jejunum is a rare surgical entity.

7. A case of intussusception in a seven month old child due to leiomyosarcoma of the jejunum is reported, with a two-year follow-up.

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Idiopathic Septic Gangrene of the Testis in the Newborn

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SEPTIC hemorrhagic infarction of the testis in the newborn is apparently rare, since no such affection in the newborn has been described in the literature. Aseptic necrosis of the testis in the newborn is also rare. It has been reported as a complication of strangulated hernia [1] and as a result of torsion of the spermatic cord [2–4]. Five cases of idiopathic hemorrhagic infarct of the testis in the newborn have been cited, one by Campbell [5], two by Mac Lean [6], one by Ravich [7] and one by the author [8]. In none of these cases was sepsis present. In all cases reported the sequela of hemorrhagic infarction of the testis in the newborn with or without demonstrable cause is an uneventful course during which aseptic testicular necrosis and atrophy ensue.

The case presented herein is the first reported instance of hemorrhagic infarct of the testis in the newborn in which symptoms of sepsis developed and in which orchiectomy promptly and dramatically cleared the sepsis. Symptoms included high temperature (106°F), pallor, facies like that accompanying shock, labored breathing and paralytic ileus.

CASE REPORT

C. V. (birth weight 8 pounds, 2 ounces) was born at the American Legion Tri-County Memorial Hospital on July 6, 1954, of a thirty-two year old multipara following normal labor, vertex presentation and spontaneous delivery.

Examination of the infant at birth revealed no abnormalities other than a discolored enlargement of the left hemiscrotum. A smooth, globular, firm, non-tender mass the size of a large olive was palpable in the left scrotum, the wall of which was bluish and non-edematous. The scrotal sac adhered to the mass, which was not elevated toward the external inguinal ring. There was no thickening of the spermatic cord between the upper border of the mass and the external inguinal ring, which was not dilated. The right hemiscrotum and its contents were normal. A provisional diagnosis of hemorrhagic infarct of the testis was made. After urologic consultation orchiectomy was recommended as an elective procedure.

The immediate neonatal period was uneventful. The infant's temperature was normal. His appetite was good. The appearance, size and consistency of the left hemiscrotum remained unchanged. On his sixth day of life the infant became acutely ill. His temperature rose sharply to 106°F. Examination at this time by the pediatric consultant disclosed rapid, shallow breathing and considerable distention of the abdomen, which was soft. The infant was pale and appeared to be in a shock-like state. The heart rate was rapid with regular rhythm. The chest was clear. No abdominal masses were palpable. The enlarged, firm, non-tender, discolored left hemiscrotum appeared unchanged from the findings observed since birth.

Laboratory studies at the onset of the acute illness were as follows: red blood count, 4,300,000; hemoglobin, 85 per cent (13 gm.); white blood count, 12,300; neutrophils, 88 per cent; lymphocytes, 12 per cent. Urinalysis disclosed no albumin or sugar. The specific gravity was 1.006. There were no abnormal elements on microscopic examination. The blood culture after forty-eight hours' incubation revealed many gram-positive cocci resembling staphylococci. Flat plate of the abdomen showed uniform air distention of the entire gastrointestinal tract. The clinical impression was sepsis and paralytic ileus due to infarct of the testis. Penicillin and strepto-

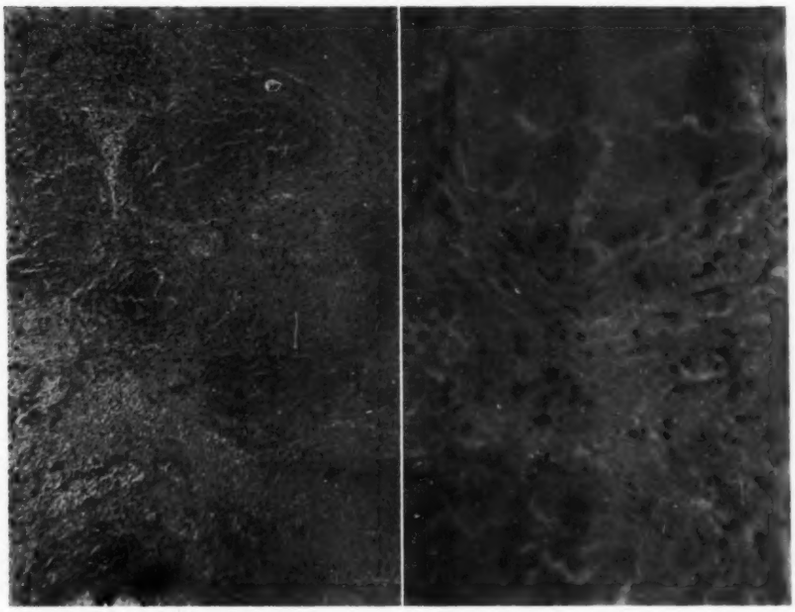

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FIG. 1. Microscopic section reveals a diffuse hemorrhagic process involving both tubules and interstitial tissue of the testis.

FIG. 2. Microscopic section (high power view) shows indistinct outlines of the tubules, the lumens of which are entirely filled with erythrocytes and a few leukocytes. Many erythrocytes lay in pools of laked blood.

mycin were given and hypodermoclysis was done, followed with immediate orchiectomy.

Under open drop ether anesthesia a left anterior longitudinal scrotal incision was made through the scrotal tunics, which were ill-defined. The tunica vaginalis was entered and a line of cleavage was obtained with difficulty between the mass and the parietal layer of the tunica vaginalis.

The mass was dark red, symmetric and the size of a large olive. The spermatic cord was not edematous or discolored. There was no twist of the intra- or extravaginal portions of the spermatic cord. The gubernaculum testis, epididymis and mesorchium were not demonstrable. The investment of the parietal tunica vaginalis was high on the spermatic cord.

An incision was made into the mass to determine the presence of testis within a possible organized hematocele. The cut surface of the mass was firm, granular and dark red without evidence of normal testis; it resembled an organized blood clot. No bleeding resulted from the incision into the mass. The intravaginal segment of the spermatic cord was incised between clamps, and the mass and its attached portion of the spermatic cord were removed.

In the postoperative period sepsis cleared rapidly and dramatically. The abdominal distention regressed considerably within one hour after orchiectomy. The temperature dropped to 101°F. on the first postoperative day and became normal on the second postoperative day. By that time the infant appeared well and antibiotic therapy was discontinued. The infant was discharged from the hospital on the fourth postoperative day.

Pathologic report revealed the following: The testis was enlarged and measured 4.8 cm. in its longest diameter. A glistening gray serosa covered a small portion of spermatic cord which was attached to the testis. The testis was firm and smooth. It had a purplish coloration resembling that of an organized blood clot. Sagittal section through the testis revealed a hemorrhagic appearance and a uniformly fine, granular surface in which the anatomic details were obscured. The appearance was not that of tumor. Dark, thick bloody fluid was expressed from the cut surfaces.

Microscopic sections of the testis (Figs. 1 and 2) exhibited a diffuse hemorrhagic process involving both tubules and interstitial tissue. The former had indistinct outlines; the lumens were entirely filled with erythrocytes and a

few accompanying leukocytes. The tubular structures were typically juvenile and were enveloped by mildly edematous basement membranes. Diffuse extravasations of blood were noted throughout all the interestitial tissue and displaced the stromal components. Engorged capillaries were noted within the pools of laked blood. Diagnosis was diffuse hemorrhagic infarct of the testis.

COMMENTS

Bluish discoloration of a smooth, firm, globular enlargement of the hemiscrotum is the outstanding clinical characteristic of hemorrhagic infarct of the testis in the newborn. The thin scrotal tunics are transparent to the symmetrically enlarged, purplish red, gangrenous testicular mass. The degree of tenderness and edema of the scrotal wall varies according to the time that the process of hemorrhagic infarction occurred during intrauterine life, labor or the neonatal period. Fever, if present, is low grade.

It is easier to make a differential diagnosis of idiopathic hemorrhagic infarct of the testis in the newborn than in infants, children and adults. For one thing, epididymitis, orchitis and torsion of the spermatic cord and of the testicular and epididymal appendixes are far more common after the neonatal period. Tumors of the scrotal contents, other than tumor of the testis, are very rare in the newborn. Tumor of the epididymis in the newborn has been reported [9]. One must consider such conditions as orchitis due to mumps, trauma or syphilis; acute and chronic epididymitis, non-specific, gonococcal or tuberculous; hydrocele; and hernia. Testicular tumor, hematocele and hemorrhagic orchitis are the diseases most difficult to differentiate.

Torsion of the spermatic cord with hemorrhagic infarct of the testis is acute in onset, with a painful, edematous and tender hemiscrotum which is discolored. Retraction of the testis upward toward the external inguinal ring is very significant. Elevation of the scrotum for support may enhance pain. Antecedent urogenital infection is not present. Hemorrhagic infarct of the testis due to torsion of the cord and followed with possible spontaneous untwisting of the cord would be indistinguishable from idiopathic hemorrhagic infarct of the testis.

Hematocele is difficult to differentiate from hemorrhagic infarct and tumor of the testis. There is usually a history of injury in hematocele. Trauma incident to labor is not easily established. Hematocele appears as a smooth, globular, discolored mass which does not transilluminate light. The consistency of the hematocele and degree of tenderness vary.

Tumor of the testis is rare, and tumor of the epididymis is rarer still. It is difficult to differentiate between hemorrhagic testicular infarct and tumor of the testis, with its insidious onset and its unilateral discolored enlargement of the scrotum which might contain bloody fluid within the tunica vaginalis. Tumor of the testis may be palpable as a firm, freely movable, nontender heavy mass. Palpation of an epigastric mass or supraclavicular lymph nodes and roentgen evidence of metastases to the lung are consistent with findings of tumor of the testis. A positive Aschheim-Zondek test is significant. Biopsy may be the only possible method of diagnosis.

Hemorrhagic orchitis results from trauma or injury to the blood supply of the testis. Herniorrhaphy occasionally produces occlusion of arterial and venous channels of the spermatic cord, and testicular atrophy ensues. Obstetric hemorrhagic infarction of the testis may follow severe traumatic or hemorrhagic orchitis incurred during labor. A testicular mass at birth, however, may require serologic tests to rule out syphilis and exploration biopsy to rule out neoplasm.

The pathogenesis of infarction and septic gangrene of the testis in the newborn remains obscure in the absence of evidence which can be correlated with the mechanism of the process. The pathologic nature of the condition establishes a process of circulatory deprivation of the testicular parenchyma. Despite the multiple sources of blood to the testis, probably no other parenchymatous organ is more vulnerable to acute, complete circulatory occlusion and total necrosis. It is not presumptuous to regard occlusion of the delicate vascular supply of the testis beyond fifteen minutes as capable of producing irreversible damage in the newborn, inasmuch as torsion of the spermatic cord beyond several hours usually causes total infarct of the testis in the adult.

Factors predisposing to the development of this condition are probably related to topo-

graphic variations of the scrotal contents which permit excessive mobility and transitory rotation of the testis. Such anatomic variations include a high investment of the tunica vaginalis on the spermatic cord, a long intravaginal segment of the spermatic cord and absence of the gubernaculum testis and mesorchium. Trauma, exertion and labor would provide superimposed influences capable of effecting complete or temporary circulatory occlusion and necrosis.

In the case reported herein surgery revealed a long intravaginal segment of the spermatic cord, a high investment of the tunica vaginalis and no evidence of torsion of the spermatic cord. In this case the discolored enlargement of the scrotum at birth and the pathologic findings would place the onset of the process of infarction of the testis as during intrauterine existence or during labor.

Since extraneous influences superimposed upon anatomic variations of the scrotal contents contribute to testicular infarction, the undescended testicle at birth is perhaps more desirable than the descended scrotal testis subject to influences incident to intrauterine residence and labor. Obstetric hemorrhagic infarction of the testis is undoubtedly far more common during normal labor than is generally appreciated; and its precursor, hemorrhagic orchitis, is probably not infrequent. The relationship of septic infarction of the testis during intrauterine life to unexplained maternal fever warrants consideration.

The development of acute onset of sepsis, which previously has not been known to occur in the few reported cases of hemorrhagic infarction of the testis in the newborn, is related to parenchymal testicular necrosis that is predisposed to inflammatory change. However, histologic examination of the infarcted testis disclosed no suppuration or extensive inflammatory infiltration that could be correlated with the severe degree of sepsis and reflex neurogenic symptoms.

When there is a discolored enlargement of the hemiscrotum in the newborn, surgical intervention is indicated for decompressing a hematocele to spare the testis from pressure atrophy, for testicular tumor and hemorrhagic infarct, and for diagnosis by accomplishing exploration biopsy. In view of the findings in this case, orchiectomy is indicated for hemorrhagic infarct of the testis in the newborn for prophylaxis against sepsis. It is required at once if the sepsis is fulminating.

SUMMARY AND CONCLUSIONS

1. Septic gangrene of the testis in the newborn, not previously described in the literature, may occur in hemorrhagic infarct of the testis.

2. Although aseptic necrosis and atrophy of the testis are the usual sequelae in the few known cases of asymptomatic hemorrhagic infarct of the testis in the newborn, a very severe manifestation of sepsis may supervene.

3. Immediate orchiectomy results in dramatic clearing of sepsis.

4. Bluish discoloration of a smooth, firm, globular enlargement of the hemiscrotum is the outstanding clinical characteristic of hemorrhagic infarct of the testis in the newborn.

5. Extraneous influences such as trauma, exertion and labor superimposed upon anatomic variations of the scrotal contents contribute to testicular infarction in the newborn. The condition of undescended testis at birth is a more protective and desirable situation than is the descended scrotal testis which is vulnerable to deleterious extrinsic effects incident to intrauterine residence and labor.

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Left Paraduodenal Hernia

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A SURGEON so often is confronted with the unexpected and is led far away from his planned procedure. In no operative site can this happen more often than in the abdomen. His ingenuity is often taxed and a review of his knowledge of anatomy is needed, as in the case reported herein. The rarity of left paraduodenal hernia immediately arouses one's surgical curiosity.

Huschke and Treitz, 1844 to 1857, first described the duodenojejunal fossa. It is at this flexure that most retroperitoneal hernias occur. Moynihan's [1] classification of nine types is well known. Only two of these are important, i.e., those that have as their bases the paraduodenal fossa of Landzert and the fossa of Waldeyer. The precipitating factors in initiating this hernia are never known. A review of the theories of the formation, with a history of these types of hernias, has been excellently presented by Murray [2].

The left paraduodenal hernia has as its sac the peritoneum covering the fossa of Landzert which is to the right of the inferior mesenteric vein, the left colic artery being to the lateral side. Thus most of the left paraduodenal hernias have in the neck of their sacs the inferior mesenteric vein. Lower and Higgins [3] believe this vein "may form a point of resistance" and promote further herniation. Many of these hernias are small, but in the case reported herein and in that of Desjardins [4] the hernias were both very large. There are approximately three times more left paraduodenal hernias than right, and most often they are found in males.

The asymptomatic nature of most of these hernias makes preoperative diagnosis improbable. The few symptoms that are sometimes present are usually vague. Belching, occasional distention and constipation may be present but physical examination usually reveals nothing unusual. Persistent complaints may suggest roentgenoscopy and a diagnosis can then be made, as Parsons [5] has so well illustrated. Therefore, due to the lack of clinical features the incident of this condition is very difficult to ascertain.

Once the anatomic diagnosis has been made and verified, the surgical procedure must be patterned to fit the case. Some surgeons have only reduced these left paraduodenal hernias and claim that recurrences are rare. Others have closed the neck of the sac after reduction. Few have excised the sac. Reduction of the right paraduodenal hernia is many times more hazardous, and repair is often impossible.

It was possible to take the accompanying photographs because of the immediate availability of a good camera. Because of the interest in, and importance of, completely authenticated findings of rare conditions in the field of surgery, it is advisable that every surgeon include a camera as part of his equipment. Some hospitals now furnish these and it is hoped that this practice will become even more universal.

CASE REPORT

The patient, a twenty-eight year old woman, became acutely ill the night before admission to the hospital. She became nauseated and had subsequent vomiting with considerable abdominal pain and soreness. Upon examination her maximum point of tenderness had localized slightly to the right of the umbilicus. There was rigidity and rebound tenderness: the white blood cell count was 13,000 and her temperature was 100.4°F. Her physician made a diagnosis of acute appendicitis.

Her past history was negative except for the usual childhood infectious diseases. However, she remembered that she had been a "chunky child" and early in life had had frequent attacks of abdominal cramps and had been

FIG. 1. Transverse colon and stomach overlying sac.

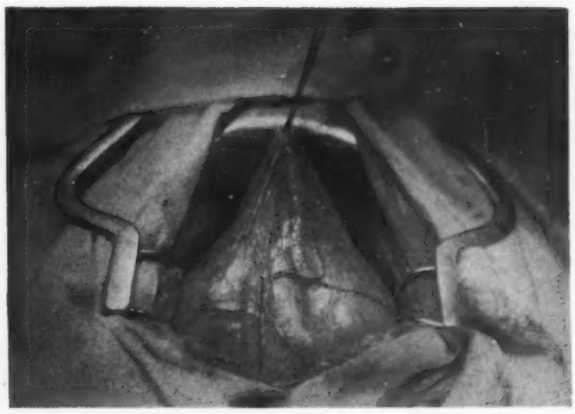

FIG. 2. Hernial sac down to pelvic brim.

FIG. 3. Acute appendix and hernial sac.

FIG. 4. Dilated neck of sac with partially reduced small bowel.

habitually constipated. Since adulthood none of these symptoms had been present.

On operation the acutely inflamed appendix was found drawn up to a mid-abdominal position. This was due to the fact that the entire small bowel was enclosed in a left paraduodenal sac. (Fig. 1.) The stomach and transverse colon lay high on the sac and laterally it was surrounded by the ascending and descending colon. The pelvis was clear except for the sigmoid, uterus and adnexa. (Figs. 2 and 3.)

After the appendix was removed, the opening into the hernial sac could be felt at the ligament of Treitz. No pulsation could be felt in this tight, thickened edge of the sac and no major vessels could be seen.

With gentle dilation of this neck, an opening was made sufficient for the reduction of the entire small bowel. (Fig. 4.) The sac, which measured 22 by 15 cm., was then opened and excised. (Fig. 5.) The small bowels then assumed their normal pattern.

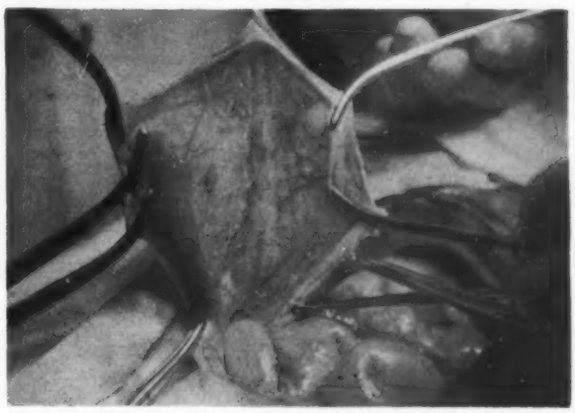

FIG. 5. Sac opened, ready for excision.

Histopathologic examination of the hernial sac revealed nothing remarkable. The cord-like border of the neck of the sac showed only small blood vessels and widely separated nerve branches. (Fig. 6.) This made it possible for complete excision. This finding agrees with Aird's [6] postulation that long-existing sacs

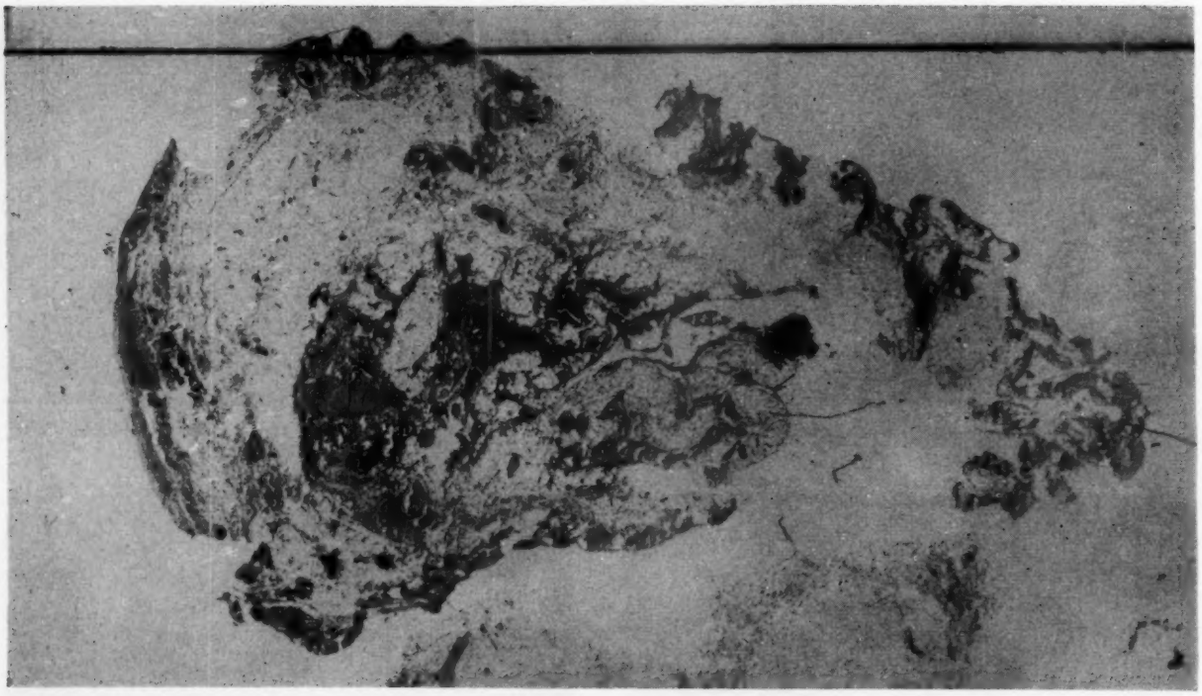

FIG. 6. Cord-like border of neck of sac.

develop collateral circulation around the inferior mesentery which is usually found in the thickened border of the opening of the sac.

The patient had an uneventful recovery. She left the hospital on the fifth day and has remained well since.

SUMMARY

A brief summary of the history and anatomy of left paraduodenal hernia is given.

A case is presented in which the entire sac was excised.

The value of readily accessible photographic equipment is noted.

Although paraduodenal hernias are rare, they should be considered when abdominal symptoms are vague and there are no abnormal physical findings.

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Aberrant Cystic Thymus Gland of the Neck

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COMPLETE or partial failure of descent of the thymus gland has rarely been reported. In 1944, Hyde, Sellers and Owen [1] reported the removal of a cystic thymus gland weighing 36 gm. from the right side of the neck of a five year old boy. The tumor was located below the angle of the mandible and anterior to the sternocleidomastoid muscle. Other reports of incompletely descended and cystic thymus tissue within the neck were reported by Heinz [2], Weller, Pearce and Rapaport [3] and Gilmour [4]. In Gilmour's case, cystic thymus tissue occurred in association with a parathyroid gland. In all instances, cystic thymus tissue arose within the neck of infants or young persons.

Abnormal cervical localization of thymus gland tissue is determined by arrest of the thymic primordia as they descend through the neck structures toward the mediastinum of the embryo. According to Patton [5], a single thymic primordium originates from each of the third pharyngeal pouches of the human embryo as a ventral evagination during the latter part of the sixth week of development. Descent of the thymic primordia, which enlarge and fuse at the midline of the neck, progresses into the eighth week of embryonic development. At this time the fused primordia begin their gradual descent under the sternum and into the anterior superior mediastinum. Apparently it is during this early period of development that thymic primordial tissue becomes arrested within the neck, and develops later and presents as a malformation.

The commonly considered congenital cystic tumefactions of the neck are branchial cleft cyst, cystic hygroma and thyroglossal duct cyst. The following case is presented to emphasize further the necessity for broadening this differential diagnosis of cystic tumefactions of the neck to include persistent cystic thymus gland tissue.

CASE REPORT

A six year old white boy was first seen on March 25, 1955 because of a large lump which had been present in his neck for several weeks. (Fig. 1.) It had gradually increased in size. On examination, a 8 by 4 cm. cystic fluctuant mass was palpated within the left anterior cervical region. This mass extended beneath the left sternocleidomastoid muscle downward from the angle of the mandible to the level of the left clavicle. The mass was not tender and the lymph nodes were not enlarged. Physical examination revealed no other abnormalities.

FIG. 1. The mass can be seen bulging from beneath the left sternocleidomastoid muscle.

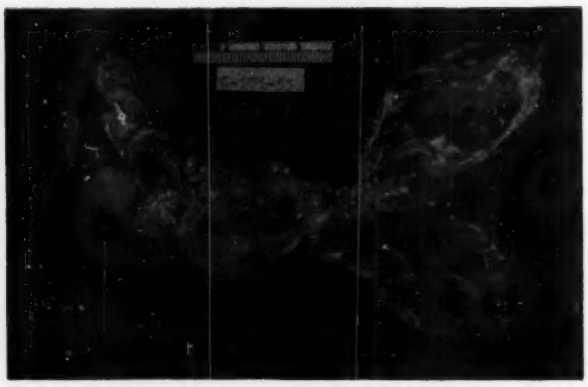

FIG. 2. Appearance of the sectioned surface of the tumor including the cyst.

The laboratory findings, which included a serologic test for syphilis, a complete blood count and differential count as well as urinalysis, were within the normal range. Preoperative roentgenograms were not made. The clinical diagnosis was that of a branchial cleft cyst.

The incision was performed under nitrous oxide, oxygen and ether anaesthesia. It extended transversely for 10 cm. beginning at the posterior border of the middle of the left sternocleidomastoid anteriorly to the midline. The sternocleidomastoid muscle was reflected posteriorly and outwardly and the mass was exposed. The mass was superficial and attached to the carotid sheath as well as anterior to the left trapezius and prevertebral sheath muscles. Superiorly, the mass was bounded by the mastoid process. Pharyngeal communications could not be demonstrated. The left pleural apex was lateral and posterior to the mass and was not exposed during the operative procedure.

The lower portion of the mass extended downward laterally to the trachea and into the anterior mediastinum. Its lower edge terminated against the anterior superior margin of the pericardium. The mass was excised intact, bleeding points were controlled with fine silk sutures and the wound margins were approximated. The postoperative course was uneventful.

The pathologic report was as follows: The specimen was composed of an elongated lobular mass measuring 12 by 5 by 5 cm. The surface was covered with roughened blood-stained fibrous tissue. On section, the upper portion of the mass contained a unilocular 5.5 cm. cyst (Fig. 2) which was filled with yellow turbid fluid containing suspended glossy fine yellow crystals. The lining of the cyst was smooth in texture, coarsely trabeculated and discolored by areas of hemorrhage. The remainder of the mass was lobulated, rather soft and pale yellow in appearance.

Histologic examination revealed an almost completely unlined cyst. Focal areas of the lining surface were covered by flattened pavement epithelium. (Fig. 3.) The remaining wall and its margins were composed of dense, compressed and proliferated fibrous connective tissue in which were found scattered and aggregated lymphocytes, as well as many dilated lymphatic spaces. The wall of the cyst contained irregularly scattered focal areas of fatty material with cholesterol which were marginated by histiocytes and occasional foreign body type giant cells. Many histiocytes were filled with phagocytosed hemosiderin pigment. Variable amounts of thymic tissue were seen within the wall of the cyst. This tissue was lobulated with formation of cortical and medullary areas. The latter areas contained Hassall's corpuscles, some of which had undergone either coagulative necrosis or calcification. The thymic tissue adjacent to the wall of the cyst contained occasional small germinal centers. Sections of the solid portion of the mass revealed histologically normal thymus tissue. (Fig. 4.)

COMMENT

The locations of persistent cystic thymus tissue within the neck have been variable as noted in the few available case reports. In the case of Hyde, Sellers and Owen [1], the tumor was located high within the anterior cervical triangle. In the case of Weller, Pearce and Rapaport [3], as in this case, both the anterior and posterior cervical triangles were occupied by the tumor. In two cases reported by Moseley [6] and Arnheim [7], the tumor was situated within the suprasternal notch. Characteristically the ectopic tissue has been found deep to the sternocleidomastoid muscle when within the lateral neck. Thus the location of the tumor does not aid greatly in exact diagnosis.

The etiology of cyst formation within thymus tissue is somewhat conjectural. Speer [8] has suggested five possible modes of pathogenesis: (1) from embryonal remnants, (2) from sequestration of involuted areas, (3) from

FIG. 3. The wall of the cyst is partially lined by pavement epithelium. A lymphatic space can be seen within the thymic tissue of the wall. Hematoxylin and eosin, original magnification × 100.

FIG. 4. Thymus tissue of the main mass showing both cortical and medullary areas. Hematoxylin and eosin, original magnification × 150.

degenerating Hassall's corpuscles, (4) from blood vessels or lymph vessels, and (5) from neoplastic processes.

Our cyst was unlined except for a few foci of pavement epithelium which seemed to arise from reticuloepithelial cells. There were many lymphatic channels within the wall of the cyst which were in communication with its lumen. We believe that the cyst in our case probably arose in pre-existing lymphatic channels within the thymus gland.

Other possible modes of pathogenesis could not be substantiated.

SUMMARY

A case report is presented of an aberrant cystic thymus gland within the right side of the neck of a six year old boy.

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Lymphosarcoma of the Rectosigmoid

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From the Surgical Department of the Mount Zion Hospital, San Francisco, California.

LYMPHOSARCOMA of the sigmoid and rectosigmoid occurs relatively rarely. The most common locations in the gastrointestinal tract are the stomach and ileum. In the colon, the ileocecal and rectal lesions are the most common.

Corner and Fairbanks [*1*] reported two cases of involvement of the sigmoid colon in 175 cases of lymphosarcoma of the gastrointestinal tract. Ullman and Abeshouse [*12*], in a report of 103 operative cases, recorded one lesion in the rectosigmoid. McSwain and Beal [*6*] found one case of sigmoidal involvement in a group of twenty cases. In a review of forty-five cases Raiford [*7*] reported no sigmoidal lesions.

There have been numerous theories concerning the origin of this lesion, but the theory evolved by Rankin [*8*] has been generally accepted throughout the years. The lesion is thought to arise in the lymph follicles of the gastrointestinal tract as a primary or metastatic growth. Extension occurs into all bowel layers except for the serosa. Ulceration of the mucosa is common. In contrast to carcinoma there is dilatation of the involved segment rather than constriction; this is thought to be due to involvement of the intrinsic nerve supply with paralysis.

Grossly, one finds a rather elongated segment of bowel involved by a firm, rubbery, nodular mass with a grayish white homogeneous cut surface. Local involved lymph nodes have the same consistency.

The nomenclature has been somewhat confusing, with such descriptive terms as lymphoblastoma, malignant lymphoma, lymphocytoma, granulomatous pseudoleukemia and intestinal Hodgkin's disease being used. There is less confusion when one remembers the cellular origin from the basic cell type present in a lymph follicle, namely, lymphocyte, reticulum cell and endothelial cell.

The prognosis of this lesion is poor. Sugarbaker and Graver [*11*] reported a 42 per cent five-year survival in malignant lymphomas of the gastrointestinal tract subjected to early surgical management. This includes the gastric and ileocecal lesions which have a better prognosis as a rule than the colonic lesions. It is rare to find a localized lesion in the latter group. Ullman and Abeshouse [*12*] reported twelve five-year survivals in 103 operative cases. Seventeen and six-tenths per cent died in the immediate postoperative period and another 17.6 per cent were dead within one year.

This diagnosis is rarely made preoperatively since the clinical picture is not unlike that of carcinoma of the lower colon. Emphasis has been placed on the consideration of this condition in the patients with symptoms of weight loss, constipation and rectal bleeding of one to two months' duration with findings of anemia, cachexia and an elongated, large colonic lesion on barium enema studies.

Most reports agree that postoperative x-ray therapy is indicated and is recommended as soon as the wound is healed. There is some question as to the value of nitrogen mustard therapy; this treatment is not recommended by our Hematology Department. There is a paucity of reports concerning the increase in the rate of five-year survivals by x-ray therapy in sigmoidal and rectosigmoidal lesions. This would certainly vary greatly depending on the degree of local or widespread involvement.

CASE REPORT

D. S., a sixty-two year old white man, entered the Mount Zion Hospital on April 18, 1955, with symptoms of constipation, weakness, weight loss, and dark blood in the stool. These symptoms had been present for four to

* Deceased.

FIG. 1. Barium enema.

five months. Constipation and blood in the stool had been the first changes noticed, followed with progressive weakness and weight loss.

The past history and systemic review were non-contributory.

Physical examination revealed a man of the stated age who appeared chronically ill and was moderately pale. His blood pressure was 180/90, pulse 84 and temperature 37.2°C. There was no unusual adenopathy. The liver and spleen were not palpable. A large 7 by 15 cm. sausage-shaped mobile mass was palpable in the left lower quadrant of the abdomen. Rectal examination was essentially negative; no mass could be felt. Sigmoidoscopy revealed a narrowing of the upper rectum by an encircling edematous polypoid mass at approximately 15 cm. No biopsy specimen was taken since the obstructive symptoms with anemia warranted surgery regardless of the type of lesion.

The blood picture was as follows: hemoglobin 7.7 gm., 50 per cent; red blood cell count, 2.95 million/mm.; white blood cell count, 12,000; polymorphonuclear leukocytes, 83 per cent. Urinalysis was essentially negative. X-ray of the chest revealed no evidence of metastasis or hilar adenopathy.

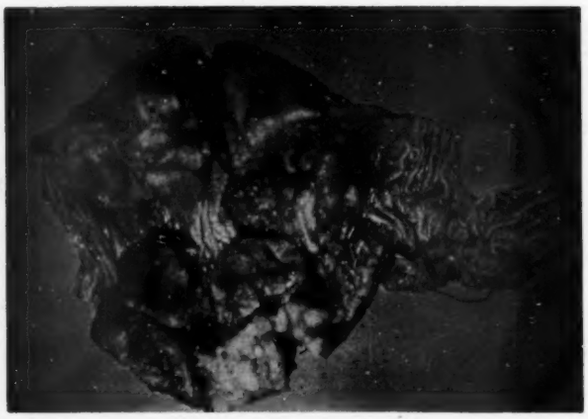

FIG. 2. Gross specimen.

Barium enema (Fig. 1) revealed a rather elongated lesion of the sigmoid colon which had the appearance of a polypoid defect of the mucosa. Several diverticula were present proximal to this area. The diagnosis was carcinoma of the sigmoid colon.

The patient's anemia was corrected by use of multiple blood transfusions, and the usual sulfathalidine® and neomycin® were administered with a non-residue diet and daily colonic flushes for preparation of the bowel.

On April 26th an exploratory laparotomy was performed through a left paramedian lower abdominal incision. A large, firm, fixed rubbery rectosigmoidal lesion was found attached to the bladder and left lateral abdominal wall with a thickened, edematous mesocolon containing large, firm rubbery lymph nodes. There were numerous lymph glands along the entire paraaortic area as high as the celiac axis. One metastatic nodule was present in the right lobe of the liver.

Because of the constipation, bleeding and poor prognosis, a palliative resection rather than a diverting colostomy was decided on, anastomosing the descending colon to the midrectum at least 5 cm. beyond the lesion. A diverting tube cecostomy was performed through a small McBurney stab wound.

The pathologic report was as follows: Grossly (Fig. 2), the specimen consisted of a segment of sigmoid colon that measured 22 cm. in length and 7 cm. in circumference at one margin of resection and 3.5 cm. in circumference at the other margin of resection. There was a large

nodular soft mass that measured 11 by 10 by 6.5 cm. Several pink-tan diverticula were noted along the serosal surface. The serosal surface of the sigmoid was light tan in color with the usual haustral markings, and several diverticula were noted whose orifices measured 0.5 cm. in size. The lobulated mass practically encircled the entire lumen of the colon. The cut surface was lobulated, in some areas soft, and in other areas firm in consistency. The margins were everted and elevated. Section through one portion of the mass showed a cavity that measured 5 cm. in maximum size. The margins of the area were necrotic and dark red in color. Careful dissection of the attached mesentery revealed seven enlarged lymph nodes.

Microscopically (Fig. 3), the sigmoid colon contained an infiltrating neoplasm of a moderately anaplastic lymphoid type. This was extremely cellular with only delicate capillaries scattered throughout. The tumor cells involved the stroma of the intact portions of the mucosa, submucosa, muscularis and adjacent pericolonic fat. There was extensive superficial necrosis with ulceration and consequent destruction of the surface mucosa. In the wall only isolated bundles of smooth muscle fibers remained. The large round tumor cells were amazingly similar in appearance. They contained well defined cell membranes and a scanty amount of faintly basophilic cytoplasm. Large round to oval nuclei occupied the bulk of the tumor cells. These had a well defined nuclear membrane and were intensely hyperchromatic with coarse chromatin granules. Most contained a single prominent red nucleolus but a few contained two or even three nucleoli. The nuclei varied moderately in size and were faintly irregular in contour. Numerous unipolar and pleuripolar mitoses were scattered throughout. From a histologic point of view these moderately anaplastic lymphoid cells were of the lymphoblastic type. In the outer wall of the bowel numerous individual tumor cells were seen in vascular channels containing many red blood cells and lined by distinct endothelium. Two of the regional lymph nodes were almost completely replaced by similar tumor tissue whose tumor cells showed the same histologic features as those of the primary neoplasm. Only a thin rim of non-neoplastic lymphoid parenchyma remained at the periphery. This was composed of small lymphocytes of bland appearance. Many loose individual tumor cells

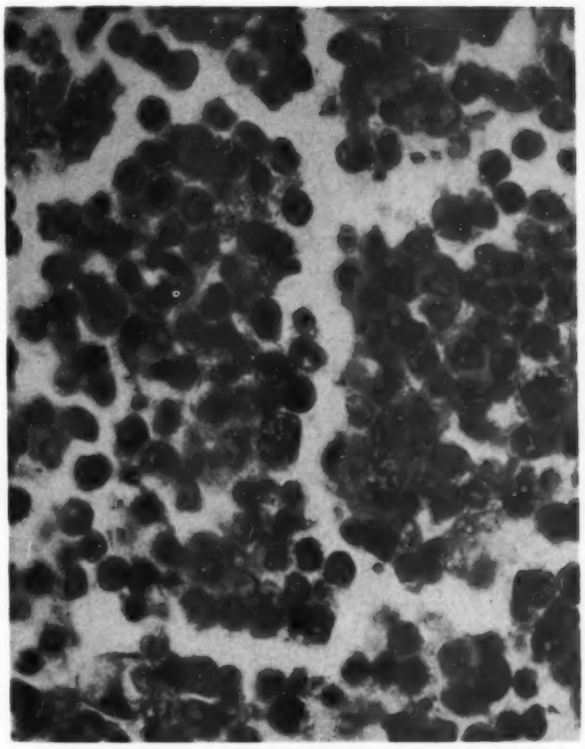

FIG. 3. Microscopic section showing typical cells.

were seen within distinct sinusoids. The other lymph nodes had a preserved architecture and an intact fibrous capsule. The follicles were distinct, contained germinal centers and were separated by lymphatic sinusoids.

The *diagnosis* was as follows: (1) sigmoid colon containing a primary infiltrating lymphosarcoma of lymphoblastic type; (2) two regional lymph nodes containing lymphoblastic lymphosarcoma, probably metastatic from the primary sigmoid tumor; (3) regional lymph nodes showing reactive hyperplasia.

The postoperative course was satisfactory although the patient recovered slowly. When he was discharged from the hospital, he was on a regular diet and was having daily normal bowel movements.

SUMMARY

A case of lymphosarcoma of the rectosigmoid is reported as an unusual location of this process in the gastrointestinal tract. A review of the literature of gastrointestinal lymphosarcoma is included.

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We recommend:

Radium Therapy. Its Physical Aspects and Extensions with Radioactive Isotopes. By C. W. Wilson, M.SC., PH.D., F.I.P. Foreword by Sir Stanford Cade, K.B.E., C.B. Second edition, 286 pages, illustrated. Baltimore, 1956. Williams & Wilkins Co., *Price* $7.50.

The Surgical Technic of Abdominal Operations. By Julius L. Spivack, M.D., Associate Professor of Surgery, University of Illinois College of Medicine, Chicago, Illinois. Fifth edition, 931 pages, 1,037 illustrations on 405 figures (mostly original), with bibliography at chapter endings and name and subject indexes. Baltimore, 1955. Charles C Thomas. *Price* $17.50. (An outstanding text for the intern and the resident in surgery.)

Duplication of the Terminal Ileum

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ONE of the rarer congenital anomalies causing obstruction of the small bowel in infants is duplication of the intestinal tract. The treatment is surgical and the results, with proper treatment, are excellent. We present such a case of duplication of the terminal ileum at the ileocecal junction resulting in complete intestinal obstruction with operation and cure.

CASE REPORT

C. R., No. 1261, a seven week old white female infant, was admitted to Kings County Hospital, Open Division, Pediatric Service on January 7, 1952, because of abdominal distention and vomiting of five days' duration. The patient was born at term and delivered with low forceps following an uneventful pregnancy. The weight at birth was 5 pounds and 11 ounces. This was the first child of parents who were both in good health.

The infant had been a feeding problem since birth and had required suppositories almost routinely to affect a bowel movement. Despite this, she frequently went an entire day without a movement. During the five days prior to admission, the infant was even more constipated than usual and enemas were given daily. These were ineffective and there was complete obstipation four, three and two days prior to admission. The mother also noted that the abdomen was becoming progressively distended. On the day prior to admission the patient had three small, loose, mustard colored bowel movements within several hours without noticeable relief of the distention. Obstipation was then again present until admission. There were frequent episodes of vomiting especially after feedings. This had been present intermittently since birth but had been constant after every feeding since the onset of the present illness, which was five days prior to admission.

Physical examination on admission revealed a well developed and fairly well nourished, moderately dehydrated, female infant weighing 8 pounds and in acute distress. The temperature was 99.8°F., pulse 120. Relevant findings were limited to the abdomen and consisted of marked distention and tenseness with tympany throughout. No spasticity, rigidity, tenderness or rebound tenderness were elicited. No masses were palpable. Bowel sounds were absent on auscultation. Rectal examination was negative. The ampulla was empty. Laboratory findings revealed hemoglobin 10.5 gm. per cent; white blood count 12,400 per cu. mm. with 60 per cent polymorphonuclear leukocytes.

The diagnosis on admission was acute intestinal obstruction of undetermined etiology. The patient was then transferred to the Surgical Service.

A flat plate of the abdomen revealed markedly dilated loops of small bowel indicative of severe small bowel obstruction. An emergency barium enema was interpreted as showing a probable intussusception in the ileocecal region.

Emergency surgery was decided upon with a preoperative diagnosis of intussusception. A cutdown on an ankle vein was performed, a polyethylene catheter inserted and infusions begun. A Levin tube was passed and Wangensteen suction was started. An antibiotic regimen of 100,000 units of penicillin every three hours and 100 mg. of dihydrostreptomycin twice daily was begun.

Laparotomy was performed five hours after admission under open drop ether anesthesia through a right rectus muscle retracting incision.

The entire small bowel was noted to be distended considerably and was approximately 4 cm. in diameter near the terminal ileum. Hypertrophy was marked. The large bowel

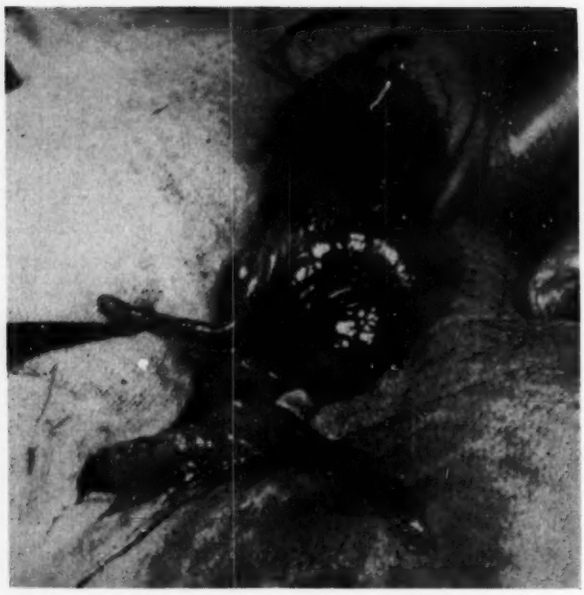

FIG. 1. Operative findings showing the markedly dilated terminal ileum, proximal diverticulum, bulging cyst, normal appendix and transverse colon with omentum.

was completely collapsed and the site of obstruction could be easily visualized as an area 1.1 cm. in diameter at the ilial side of the ileocecal junction where a firm cystic mass could be felt. This protruded both into and outside the lumen of the bowel. Just proximal to this mass a large, 1½ inch, collapsible diverticulum was noted. No intussusception was present. (Fig. 1.)

The cecum showed evidence of partial malrotation and was lying in the right upper quadrant of the abdomen. It also had a mesentery. Under aseptic conditions, the ileum was opened just proximal to the mass to determine the exact nature of the lesion. The large proximal diverticulum could easily be entered with a finger and contained no foreign material. The large obstructing cyst apparently originated in the ileal wall and protruded into the lumen. This was causing a clinically complete intestinal obstruction. A diagnosis of duplication of the ileum was made and a resection was decided upon.

Approximately 8 cm. of terminal ileum and 5 cm. of ascending colon were removed. The entire small bowel was then aspirated using the ordinary perforated aspiration tip and suction. After the small bowel was sucked out the length of the suction tip, the proximal bowel was threaded over the tip; then the remaining contents of the small bowel were gently milked between the index and middle fingers toward the tip. An end-to-end ileo-ascending colon colostomy by an open technic had been decided upon and the large bowel cut obliquely because of the disparity in size of the lumens of the large and small bowel. A quarter-inch longitudinal antimesenteric incision was also made in the large bowel to further increase its diameter. The anastomosis consisted of two layers of No. 0000 interrupted silk mattress sutures. The outer layer was seromuscular in nature and the inner took in all layers of the bowel wall. Patency was verified by easily opposing the tips of both little fingers through the anastomotic site. The rent in the mesentery was closed with interrupted plain No. 00 chromic sutures to the peritoneum and fascia, and silk for the skin.

The infant left the operating room in satisfactory condition and her postoperative course was uneventful except for a one day episode of diarrhea which occurred on the fourth postoperative day.

Infusions were continued for one and a half days postoperatively and consisted of 100 cc. blood, 500 cc. of 5 per cent glucose, 100 cc. of normal saline and 300 cc. of Ringer's solution the day after the operation, and 200 cc. of Ringer's solution the second postoperative day. Oral feedings of Ringer's solution 10 to 30 cc. every two hours were begun late on the first postoperative day when the infant had several small bowel movements and peristalsis was audible. This regimen was increased to a formula of powdered protein milk and boiled water on the third postoperative day. Because of an episode of mild diarrhea lasting for twenty-four hours, a tea and banana flake regimen was instituted on the fourth postoperative day and continued for forty-eight hours. By the sixth postoperative day the infant was on a modified evaporated milk formula which was continued until the day of discharge.

Chemotherapy was continued until the sixth postoperative day with the addition of thalmyd 0.125 gm. every six hours for the fourth and fifth postoperative day. Urinary output was adequate at all times but could not be accurately measured.

All sutures were removed on the ninth postoperative day and the wound was noted to be healed per primam.

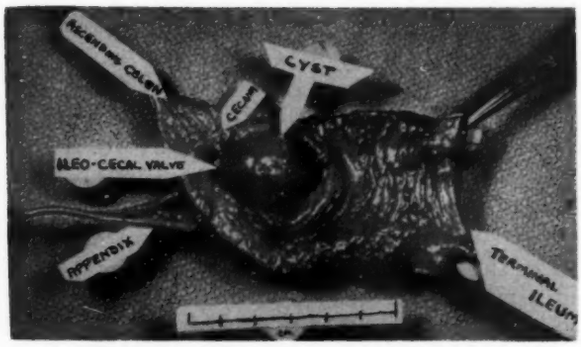

FIG. 2. The resected specimen is shown opened. The cyst, collapsed proximal diverticulum and dilated terminal ileum are evident.

FIG. 3. Fixed specimen in cross section.

Prior to the patient's discharge on February 9th, a fractional x-ray study of the small bowel was performed which visualized the entire small and large intestines. No obstruction was noted at the anastomotic site and the barium mixture passed freely into the large bowel.

Follow-up thirty months postoperatively revealed the child to be in excellent health and her bowels moving regularly. There have been no further feeding problems.

The pathologic examination of the resected specimen revealed the following. The gross specimen consisted of 7 cm. of terminal ileum, ileocecal valve, cecum, appendix and 3.5 cm. of ascending colon. In the wall of the terminal ileum, adjacent to the ileocecal valve and near the mesenteric border, was a spheroidal cyst measuring 3 cm. in its greatest diameter. Most of the bulk of the cyst bulged inward into the ileal lumen filling it, obstructing it, and tending to efface the lip of the immediately adjacent ileocecal valve. The wall of the cyst was 2 to 3 mm. in average thickness; its inner surface was gray-white, smooth and glistening; and its contents consisted of a colorless fluid with a small amount of mucoid white sediment. The ileal mucosa over the bulging convexity of this cyst was thinned and revealed a few shallow erosions. There was a similar but smaller cyst situated at the base of the larger one and partially molded over the convexity of the latter. This measured 1.5 cm. in its greatest diameter. It had a slightly thicker wall and bulged the serosal surface outward without directly encroaching into the ileal lumen. Neither cyst showed connections with the other or with the intestinal lumen.

A diverticulum-like protrusion of the ileum measuring 2 by 1.5 by 1 cm. was present proximal to the cysts and immediately adjacent to their base. Its wall was somewhat thinner than that of the ileum and its mucosa was intact and continuous with that of the main part of the ileal lumen. The stoma of this recess was broad and ill-defined.

The remainder of the specimen showed no additional abnormalities other than the presence of several large, tan, discrete mesenteric lymph nodes. (Figs. 2 and 3.)

Microscopic examination revealed a flattened mucosa of gastric type lining both cysts. The cells were mucous in character, columnar in the pits and over the surface, and cuboidal in the glands. No goblet cells or acidophilic cells were noted. The cysts had their own muscle layers which fused inextricably at the base with those of the ileal wall. A microcyst similar to the larger cysts was noted in the wall of the larger cyst. At its base, the wall of the diverticulum-like structure was essentially similar to that of the surrounding ileum except that its coat showed a gradual narrowing at the base and the mucosa a flattening of the folds.

The diagnosis was duplication of ileum (enterogenous cyst) and diverticulum of ileum.

COMMENTS

Gross et al. [1] in a total series of sixty-seven cases of duplication of the alimentary tract found 40 per cent along some part of the ileum and 12 per cent (eight cases) at the ileocecal region. The embryologic origin of the duplications is still the subject of some controversy although the explanation offered by Bremer [2] is now most generally accepted. He states that in the embryo in about six weeks, rapid

proliferation of epithelial cells completely occlude the lumen of portions of the intestinal tract. Fluid filled vacuoles then appear in this solid cell mass and gradually form a lumen parallel to the long axis of the bowel by coalescence. Cysts or longitudinal duplications are the result of abnormal coalescence of the vacuoles. These have muscle layers contiguous with or similar to that of the normal bowel. Mucosa similar to that of adjacent or distant gastrointestinal mucosa is always present unless atrophied and disrupted by pressure, ulceration or infection. (In our case there was a gastric type of mucosa lining the cysts.) Communication with the adjacent bowel may or may not exist. The one great objection to this theory, however, is the fact that there is no temporary epithelial occlusion of any portion of the embryologic gastrointestinal tract other than the esophagus and duodenum [3]. The theory of Lewis and Thyng [4] with relation to the origin of duplications as residue of normal out-pouchings of animal and human embryos of four to eight weeks of age cannot explain the requisite presence of muscle fibers in the wall.

The symptoms produced depend upon the location and size of the duplication. Those in the vicinity of the ileocecal region usually cause intestinal obstruction because of occlusion of the ileal lumen by growth or pressure on the ileocecal valve. They may be the leading point of an intussusception or may cause a volvulus. Hemorrhage or infection may occur within the cyst, and occasionally a large cyst may be palpated as a round smooth mass.

The diagnosis is usually not made preoperatively and such cases of intestinal obstruction are usually diagnosed as intussusception until laparotomy is performed.

The treatment is surgical and because the cysts and contiguous bowel usually have a common blood supply, intestinal resection is usually the treatment of choice. With recent advances in pre- and postoperative care, the mortality rate has decreased rapidly and, since 1946, Gross [1] reports a zero mortality in twenty cases. (He reports an 18 per cent mortality rate during the years 1939 to 1946.)

Associated anomalies may be present and usually are in the form of atresias of the intestinal tract. In the case reported, incomplete rotation was present and the cecum was found lying free in the right upper quadrant of the abdomen. It had a definite mesentery and was causing no duodenal obstruction.

The origin of the proximal diverticulum is of special interest in that it may be either another duplication, a so-called giant diverticulum, which communicates with the normal bowel or a manifestation of a pulsion type of diverticulum originating in a weak portion of ileum near the obstruction. This weakness is made larger by the increased intraluminal intestinal pressure and increased peristalsis over a prolonged period. The management of this case presents further proof that end-to-end primary intestinal anastomosis is feasible and practical in children. Morris et al. [5] prefer a two layer closed end-to-end anastomosis using a Rankin clamp. Dennis [6] prefers a single layer silk anastomosis. Hardaway et al. [7] used a single layer of interrupted chromic mattress sutures. We have preferred a two-layer silk interrupted mattress suture utilizing an open procedure and making allowance for the differences in diameter of the collapsed large and distended small bowel by cutting the large bowel obliquely and also making an antimesenteric longitudinal incision in the smaller loop.

In addition, the entire small bowel is sucked out prior to the anastomosis utilizing the ordinary perforated suction tip. When this is done, the tone and color of the distended bowel rapidly returns and the thin bowel wall becomes much more normal. Peristalsis usually returns within six to forty-eight hours. Closure of the abdominal wall is also considerably facilitated by the aspiration of the large amount of fluid and gas usually present in the distended intestine. In a group of twelve consecutive cases of obstruction of the small bowel with or without gangrene and resection [8], we have found the convalescence to be markedly facilitated and the postoperative care much easier to manage.

Oral feedings are begun with the onset of peristalsis and chemotherapy in the form of penicillin with or without streptomycin or aureomycin is always used.

SUMMARY

1. A case is presented of duplication of the terminal ileum in a seven week old infant operated upon successfully.

2. The question of origin of an adjacent diverticulum is noted.

3. Operation consisted of primary resection, surgical aspiration of the small bowel and end-to-end anastomosis, ileo-ascending colon colostomy.

4. The postoperative care with early feeding is described.

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Carcinoid of the Cecum with Extensive Metastases

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THE importance of carcinoid tumors has grown. Previously these tumors were considered a rarity and of a rather benign nature. However, their potential malignancy is being stressed with increasing frequency.

In 1952 Raphael [*1*] reviewed twenty-eight previously reported cases of carcinoids of the large bowel exclusive of the rectum. Of the cases reported, eighteen involved the cecum. Since that time many papers on carcinoids have appeared in the American literature [*2–8*]. The majority of these papers have dealt with carcinoids of the rectum. The predominance of reports of rectal cases is probably due not to an actual increase in the number of rectal cases but rather to an increase in the index of suspicion of all rectal nodules, together with the ease of examination of that organ. Jackman [*8*] was so impressed by the malignant potential of these tumors that he reported one case as adenocarcinoma, grade 3, carcinoid type.

The case reported herein illustrates the long history and the extensive metastases of a carcinoid tumor. It also emphasizes the insidious onset of the disease as well as the need for medical alertness and inquisitiveness in the examination and care of a patient with the rather common complaint of diarrhea.

CASE REPORT

O. B. (No. 5853), a forty-nine year old man, presented himself for admission to the hospital on June 1, 1953. His chief complaint was pain in the right upper quadrant of the abdomen and the loss of 11 pounds in the preceding few months.

In January, 1945, while he was in the service in Belgium, he had an attack of "dysentery" which lasted three or four weeks. It consisted of fifteen bowel movements a day, which were watery in character. He was ignorant of the medical findings at the time. After his discharge from the service on November 26, 1945, he had recurrent attacks of diarrhea approximately every two months. These lasted three to four days and consisted of four to eight watery stools daily. The medical attention he received during this time was cursory, at best. In 1949 the symptoms became more severe and an intolerance to fats developed. In early 1953 he experienced moderate pain and tenderness over the area of the liver. By May, 1953, the pains became excruciating and persistent, and he complained of weakness, exhaustion and a definite loss of weight. In June, 1953, he was admitted to the hospital.

Examination revealed an intelligent white man, rather well developed and nourished, who did not appear acutely or chronically ill. His temperature, pulse and respiratory rate were normal. His blood pressure was 144/100. The liver margin was hard, nodular, tender, and was palpated 7 fingerbreadths below the costal margin. Two small lymph nodes were palpated in the left inguinal region. The remainder of the examination was non-contributory.

The relevant laboratory findings were as follows: urinary urobilinogen was positive in 1:10 dilution; the bromsulfalein test showed an 8 per cent retention in forty-five minutes; the gastric analysis showed no free hydrochloride, total acid 10 degrees; and the cephalin flocculation test was 1 plus in forty-eight hours.

X-ray examination of the colon by barium enema (Figs. 1 to 3) revealed evidence of spiculization and a distorted cobblestone mucous membrane pattern. All other laboratory and x-ray findings were within normal limits.

*Deceased.

FIG. 1. Arrow demonstrates a filling defect in the right side of the large bowel without definite demonstration of the cecum as such.

FIG. 2. Arrow points to a defect in the terminal ileum with narrowing of the lumen near the ileocecal junction. Cecum shows a probable extrinsic defect.

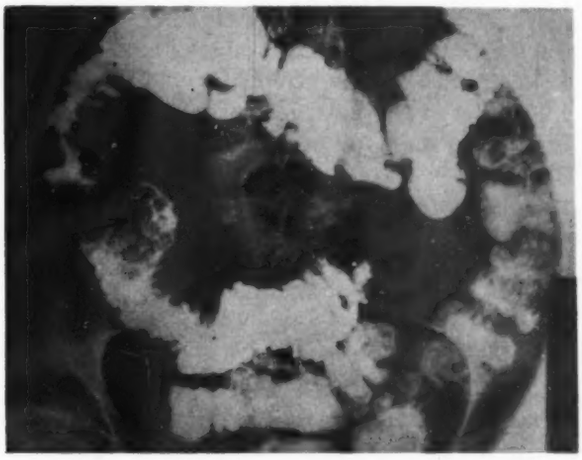

FIG. 3. Arrow shows a more definite defect in the cecum with possible intrinsic narrowing of the lumen. Mucous membrane pattern of the ileum has a cobblestone appearance in some areas with evidence of destruction toward its terminal end. The proximal small bowel shows evidence of spiculization.

On July 27, 1953, laparotomy was performed. The liver was greatly enlarged, hard, irregular and filled with many nodules of various sizes; the largest was 2 inches in diameter. A large, irregular nodular mass was found involving the cecum and terminal ileum. Resection was deemed inadvisable because of the extensiveness of the metastases. Therefore a side-to-side mid-transverse ileocolostomy was performed to divert the fecal stream and to by-pass a possible complete obstruction of the bowel in the near future. A specimen from a liver nodule was taken for pathologic examination.

Microscopic examination of the specimen was reported as follows: "Two sections are examined; each is from the liver and they are essentially similar. In each, only a small portion of liver tissue is demonstrated at one end of the section. Here the tissues show compressed lobules which are irregular and surrounded by large amounts of cellular collagenous connective tissues, occasionally infiltrated by lymphocytes. Most of the section, however, is taken up by neoplasm which is composed of rounded islands of regular cells which are small with small amounts of eosinophilic cytoplasm and with very large, very hyperchromatic nuclei which take up almost the entire cell. In some places there is an acinar appearance with what appears to be central lumens. Mostly, however, they are rounded islands of very regular cells arranged in an irregular fashion separated by delicate connective tissue stroma. Mitotic figures are not observed. Cellular outlines are

generally indistinct and the cells appear generally cuboidal or sometimes polygonal. The cellular cytoplasm is sometimes granular and sometimes has a vacuolated appearance. Diagnosis: secondary carcinoid of liver, metastatic."

The patient made an uneventful recovery. He returned for a follow-up examination on October 16, 1953, at which time he felt fairly well. His only complaint was of two loose bowel movements a day. In January, 1954, the severe abdominal pains recurred and the diarrhea became worse. On February 18, 1954, he was readmitted to the hospital for terminal care. Routine x-ray examination of the chest revealed a tremendous cardiac shadow which persisted. He had no cardiac symptoms and the electrocardiogram was normal. A diagnosis of beriberi heart was made at the time. On March 1, 1954, an acute depressive reaction developed which was manifested by threatened self-destruction, guilt feelings and hallucinations. The patient was transferred to the neuropsychiatric service where he stayed until April 7, 1954. He was then transferred back to the surgical service. By this time edema of the scrotum and lower extremities had developed. The liver had enlarged still more; ascites developed and he became bedridden. From then until he died a paracentesis was performed on four occasions to relieve his dyspnea and abdominal discomfort. Between 4,000 and 6,000 cc. of fluid were withdrawn each time. Smears and cultures of the clear-colored fluid were negative. On November 10, 1954, his condition suddenly became worse and he died, nine months after his second admission and approximately ten years after the original onset of diarrhea.

Autopsy was performed two and a half hours after death. The essential findings were as follows: The body was emaciated. Each pleural cavity contained 600 cc. of pale, clear straw-colored fluid; the pericardium contained 600 cc. and the abdomen 3,500 cc. of similar fluid. The anterior border of the liver was 5 cm. below the costal margin in the right mid-clavicular line and 12 cm. below the xiphisternum in the midline. The external surface of the liver was diffusely studded with white, firm nodules, the largest being 2 cm. in maximum diameter; some were confluent, especially in the left lobe. The mesentery of both the small and large intestine was studded throughout with small gray, firm nodules, which were also present in the serosa of the sigmoid colon and the rectum. The lower portion of the cecum contained a moderately firm mass which was 4 cm. in maximum diameter. There was a completely healed ileotransverse colostomy. The posterior wall of the right ventricle of the heart immediately inferior to the pulmonic valve demonstrated a firm ovoid body which was 1.6 cm. in maximum diameter. There was a similar structure in the posterior wall of the left ventricular myocardium, ovoid and 1.4 cm. in maximum diameter. The liver weighed 2,700 gm. On section, scattered throughout all lobes there were numerous irregular larger and smaller areas of neoplasm raised above the cut surface and umbilicated. The largest of these occupied about half the right lobe and measured 14 by 8 by 7 cm. It was composed of irregular lobules of glistening grey-white tissues. Many of the nodules were cystic while others contained areas of yellow necrosis and dark red hemorrhage as well. Many of the periaortic lymph nodes were enlarged, firm and, on section, obviously replaced by firm grey-white neoplasm. In the ascending colon 2 cm. above the ileocecal junction there was a cauliflower-like hemorrhagic mass extending into the lumen which measured 3 by 2 by 1 cm. and was relatively firm. At the line of anastomosis there were many hard nodules in the serosal surface of the large bowel, the largest being 2 by 1 by 1 cm.

Microscopic examination revealed that sections from the myocardium of both the left and right ventricles contained a large nodule of neoplasm consisting of irregularly rounded islands and solid sheets and cords of cells with small amounts of eosinophilic cytoplasm and large, hyperchromatic round to ovoid nuclei. The cell boundaries were often indistinct.

Two sections from the liver demonstrated large areas of neoplasm consisting of rounded islands and solid sheets and cords of small cells which were polygonal or cuboidal with granular eosinophilic cytoplasm and which had hyperchromatic round to ovoid nuclei.

The section from the cecum, taken from the area of the tumor grossly described, was covered at one edge by natural epithelium which was suddenly invaded by obvious growth from below. The neoplasm consisted of rounded islands and solid sheets and cords of cells which presented a uniform appearance throughout. There was a scanty connective tissue stroma in

which there were communicating columns and surrounded nests of epithelial cells which were regular, cuboidal, polygonal or polyhedral with granular eosinophilic cytoplasm and large round nests of reticulated nuclei. Pleomorphism was conspicuously absent, as were mitotic figures. Silver stain revealed argentaffin granulations in the cytoplasm in many of the cells both here and in the metastases described elsewhere.

The architecture of the lymph node was completely replaced by solid sheets, cords and islands of neoplasm with cells similar to those previously described.

The pathologic diagnoses included: (1) carcinoid of the cecum; and (2) secondary carcinoid, metastatic to the liver, heart, abdominal lymph node, mesentery, serosa of the large intestines, and the pancreas.

SUMMARY

The malignant nature of this tumor is stressed. Since the natural history of this neoplasm seems to be one of relatively slow growth and late metastases, early diagnosis and complete extirpation are extremely important.

Although most reported cases of carcinoid are of the the appendix, small bowel or rectum, this tumor does occur elsewhere and should be considered in the differential diagnosis of tumors of the cecum as well as elsewhere in the gastrointestinal tract.

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Hyperplastic Tuberculosis of the Rectum

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THAT hyperplastic tuberculosis is probably the rarest of rectal lesions is indicated by the paucity of reported cases. It appears from case reports that the most frequent site of a tuberculoma of the bowel is in the cecum, with decreasing frequency as the anus is approached. Just why this should be the case is not known, for there is no apparent anatomic or physiologic explanation unless it is that the farther the bacillus travels the less likelihood is there of its survival and inoculation. Such a theory is, of course, applicable both in those lesions associated with pulmonary tuberculosis and in those in which there is no apparent pulmonary involvement and which are believed to be the result of oral ingestion of the offending organism. That hyperplastic tuberculosis may involve any part of the bowel, and that lesions may be either single or multiple and even occasionally involve the entire bowel in the tubular lesion in no way invalidates such a hypothesis.

In relative frequency the ulcerative type of tuberculosis of the bowel is more common. It is usually found to be secondary to pulmonary tuberculosis or, more rarely, a primary lesion elsewhere. The hyperplastic form, in contrast, is rarely ulcerated. When ulceration does occur, it is usually quite superficial. The latter type is usually assumed to be a primary lesion, although this is not necessarily true. It is generally stated that such a primary lesion is of a bovine strain and that associated abscesses, fistulas and tubercular peritonitis are relatively uncommon.

The symptoms produced by tuberculoma of the bowel will, of course, resemble those of any obstructive or semi-obstructive lesion. One will therefore anticipate more pronounced symptoms the more distally the lesion is located. In general, however, the symptomatology will suggest carcinoma except for the absence of bleeding, unless there is associated disease which is productive of blood.

A lesion which is palpable or visualized on sigmoidoscopic examination will be rather confusing in that one will find a firm tumor mass occupying the lumen of the bowel which is most suggestive of carcinoma, except for the absence of ulceration and bleeding. If there should be associated narrowing of the lumen of the bowel with thickening of the walls, one may then add lymphogranuloma venereum as a clinical possibility. The final diagnosis will rest upon adequate laboratory studies including serology, the Frei test, x-ray study and the indispensable biopsy. Just how soon one may anticipate a definitive diagnosis from the pathologist will depend on the tissue removed. In the event proper staining technic demonstrates the acid-fast bacillus with characteristic Langhans' giant cells in tubercles associated with central necrosis, the diagnosis will be promptly established. If this classic microscopic finding is not demonstrated, one must await the outcome of culture studies and guinea pig inoculation; however, it is my belief that these two procedures are of value only in the event of a positive report and that a negative report should not be considered conclusive but only indicative of the necessity for restudy.

Until very recently surgical excision was considered the treatment of choice. Today the general concensus is toward a more conservative approach; and with the use of the recent antituberculosis drugs surgery may be required chiefly for obstructive and cicatricial cases, as well as for tuberculomas which fail to respond to medical measures.

CASE REPORT

A fifty-two year old Latin-American man was first seen on April 8, 1953. He was referred with a diagnosis of rectal carcinoma. This man complained of rectal pain which had become progressively worse for a period of five or six

months and was now constant. There was tenesmus, and he stated that he might visit the toilet as often as fifty times daily, although passing stool only three or four times. For the past twelve months he had felt that his bowel movements were not satisfactory and he believed there had been a gradual reduction in the caliber of the stools. For a similar period there had been a few drops of blood from time to time while straining at stool. There had been a weight loss of approximately 56 pounds during the previous twelve months. Aside from this the patient's proctologic history was normal. Review of systems revealed nothing of significance, and the patient stated that his general health had been quite satisfactory until the onset of his present illness.

This patient was tall, well developed and apparently well nourished despite his stated weight loss. Proctologic examination disclosed an annular stricture 8 cm. above the anus. There was a hard mass approximately 5 by 3 cm. protruding into the lumen of the rectum posteriorly and inferior to the stricture, with a downward extension to the pectinate line. The mass was not ulcerated.

Biopsy was taken and the clinical diagnosis was carcinoma, probably scirrhous, advanced.

The pathologic report was as follows: Grossly, the specimen consisted of three irregular ovoid pieces of tissue, the largest of which measured 1.2 cm. in length and up to 6 mm. in diameter. The tissue was somewhat friable and gray.

Microscopically, sections of the tissue showed it to be almost entirely composed of inflammatory tissue with small bundles of smooth muscle in a few areas. In this tissue were round or oval groups of epithelioid cells, some of which surrounded central giant cells of the Langhans type. About these tubercles there was a dense infiltration by lymphocytes, plasma cells and histiocytes. Areas of necrosis were present in some of the larger tubercles, and areas of fibrosis surrounded others. Portions of the necrotic areas were densely infiltrated by neutrophils.

The pathologist stated that other conditions such as lymphogranuloma venereum and various mycotic diseases might have caused this type of tuberculoid inflammation. There was no evidence of malignancy.

The diagnosis was probable tuberculous proctitis.

On receiving the foregoing report lymphogranuloma venereum was considered and the patient was called in for a Frei test, a second biopsy and further questioning. Although he admitted to extramarital activities during the preceding twelve months, the contacts were such that lymphogranuloma venereum was unlikely, although it could not be completely ruled out.

The pathologic report of the second biopsy was as follows: Grossly, the specimen consisted of four irregular ovoid pieces of tissue, the largest of which measured 8 mm. in diameter. The tissue appeared to be covered on one surface by mucous membrane. On section it was firm and gray.

Microscopically, section of the biopsy specimens showed most of them to be covered by intact rectal mucosa. In some areas this mucosa was replaced by inflammatory tissue, and in other areas signs of regeneration were present in the mucosal glands. Some portions of the biopsy specimen consisted almost entirely of inflammatory tissue similar to that seen in the previous biopsy. This showed foci of caseous necrosis containing neutrophils which were surrounded by epithelioid cells and a few giant cells of the Langhans type. Vascular fibrous tissue surrounded these structures and there was a dense infiltration by lymphocytes, plasma cells and histiocytes. In some of these sections a similar type of tuberculoid inflammation was seen in the submucosa beneath fairly well preserved mucosa. There was no evidence of malignancy. As reported previously, this was a tuberculoid type of inflammation and could be caused by agents other than tubercle bacilli.

The diagnosis was chronic granulomatous (tuberculous) proctitis.

The Frei test was reported to be negative at intervals of forty-eight, seventy-two and ninety-six hours. A supplemental pathologic report was as follows: Acid-fast stains in the sections showed large numbers of acid-fast bacilli morphologically typical of Mycobacterium tuberculosis. Diagnosis: tuberculous proctitis.

With this information at hand the patient was referred to his attending physician with the suggestion that his chest be examined radiologically, and in the event of pulmonary tuberculosis that he be sent to the local tuberculosis hospital.

X-ray examination of the chest revealed active tuberculosis, and on May 8th the patient was admitted to Weaver Baker Hospital. He discharged himself ten days later, on May 18th. The summary of his hospitalization is as follows: At the time of admission his temperature was 102°F. and varied between this point and normal during hospitalization. Physical examination of the chest indicated diminished resonance in the upper part of both lungs with mixed rales in these areas. Five sputum examinations were negative, with one positive. Urinalysis was essentially negative. The red blood cell count was 4,300,000, white blood cell count 6,500, and hemoglobin 84 per cent; serologic study was negative. On x-ray examination there was haziness in the right apex. Mixed-type infiltration was scattered from the apex to the fourth anterior interspace. On the left, mixed-type infiltration was scattered from the apex to the fourth anterior interspace. There were small areas of honeycombing in the apex. The costophrenic angles were obliterated. Treatment was symptomatic during the patient's hospitalization.

Final cultures from the biopsy material were reported as showing no growth.

SUMMARY

Report of a hyperplastic tuberculous lesion (tuberculoma) of the terminal rectum has been presented. It is believed that this is the most distal tuberculoma of the bowel recorded to date. The difficulties of diagnosis and the necessity for careful pathologic study have been illustrated. It is to be noted that in this case the hyperplastic tuberculous condition of the rectum was not a primary lesion.

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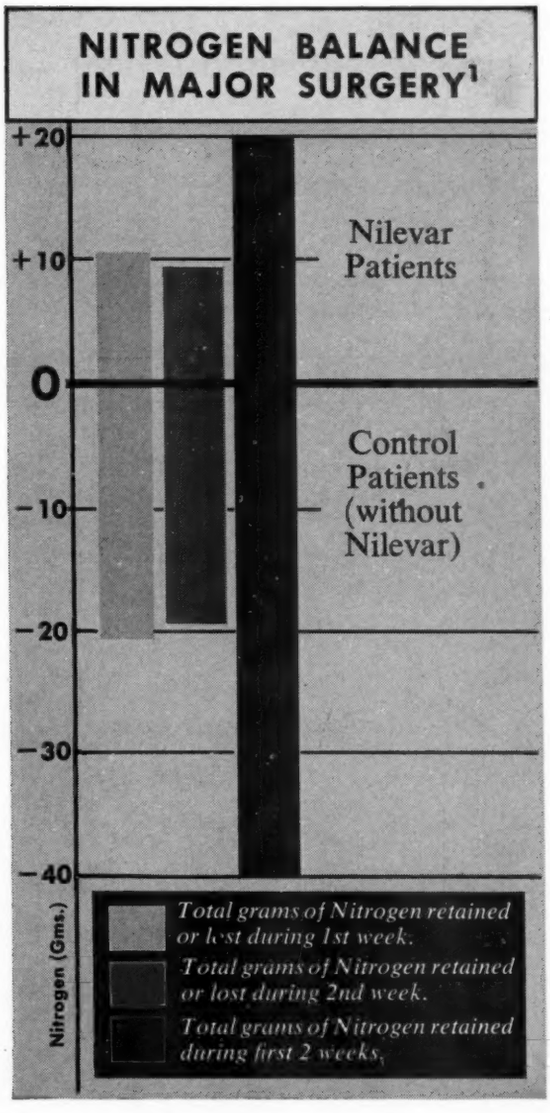

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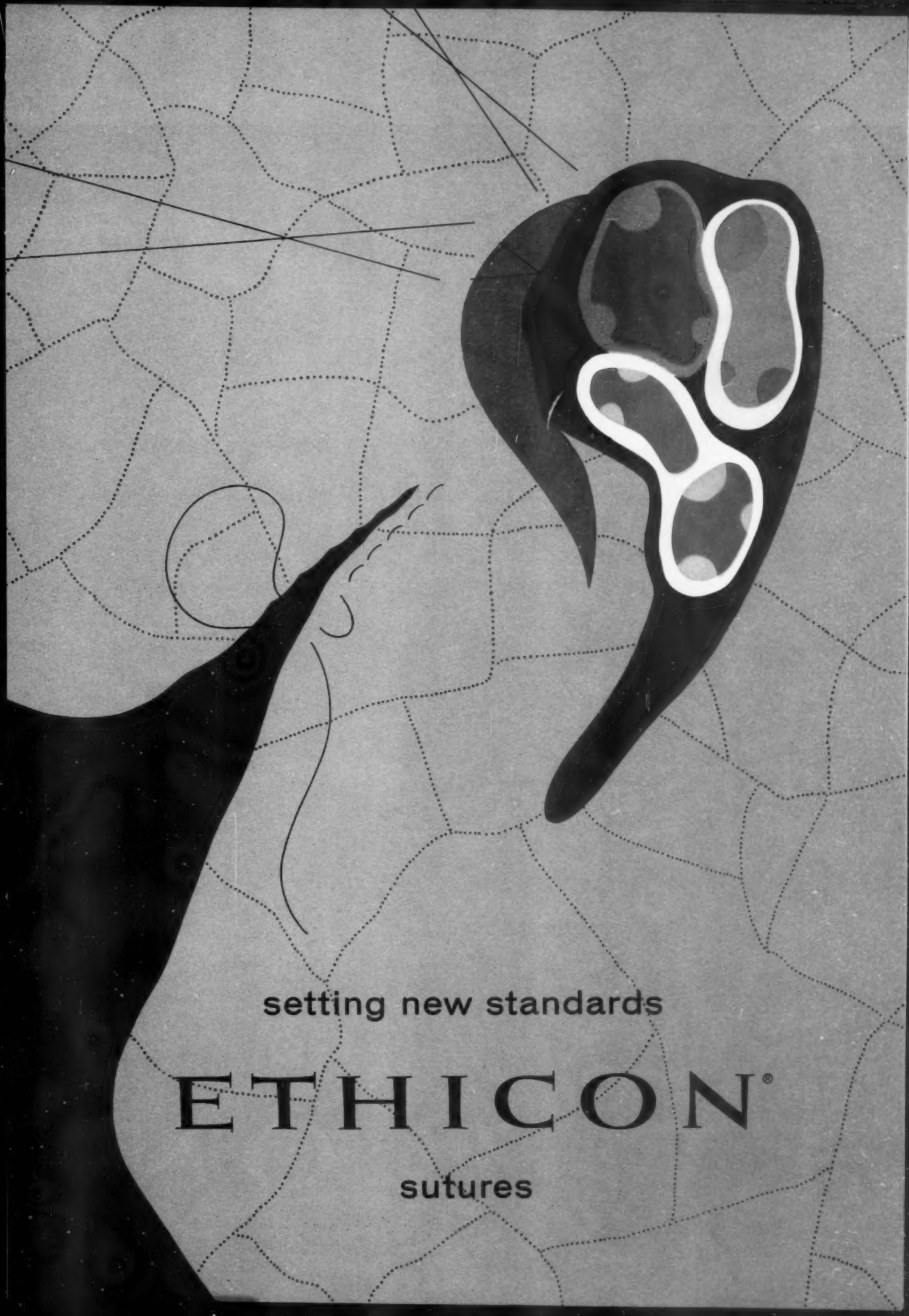
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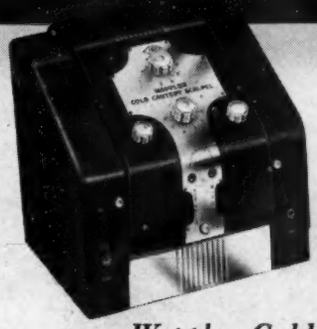

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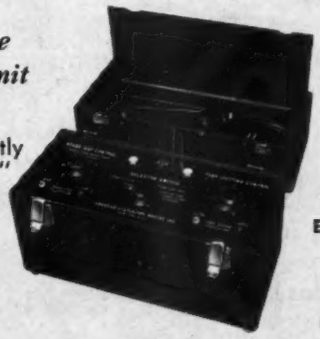

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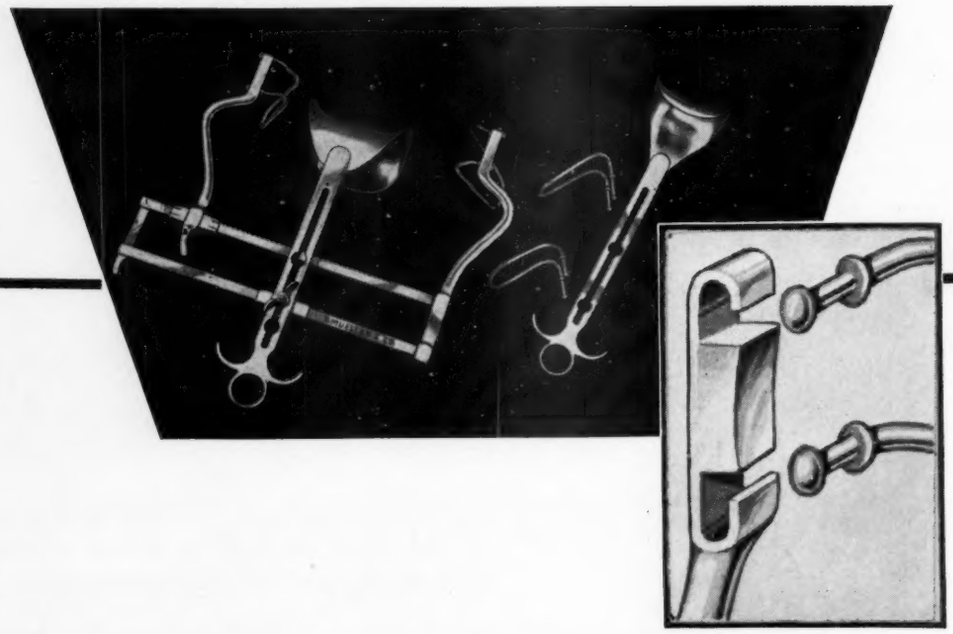

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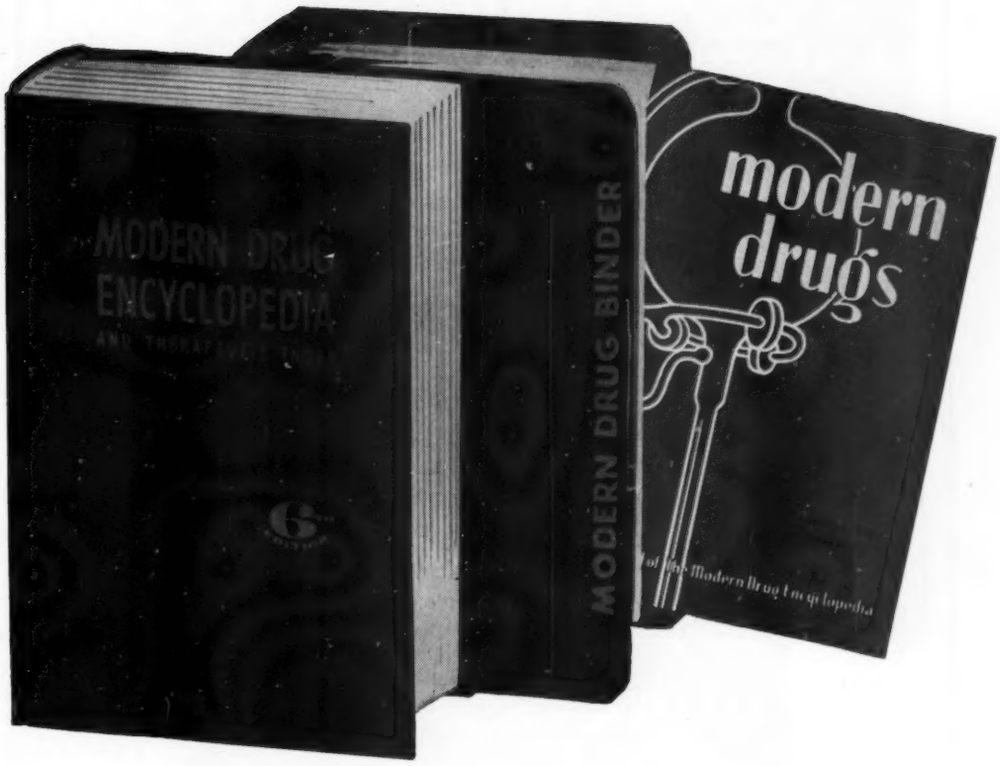

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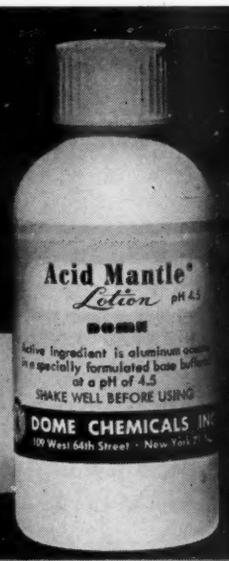

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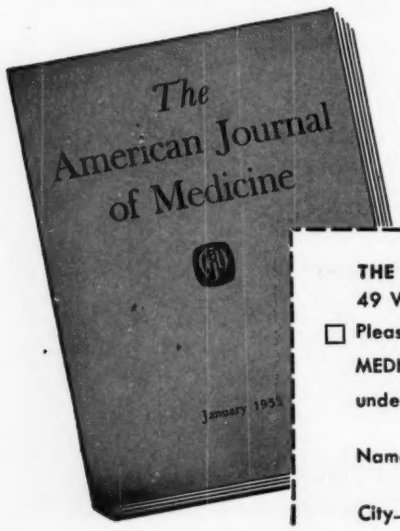

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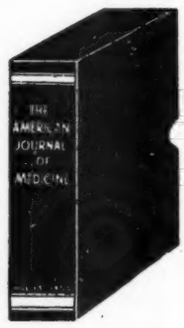

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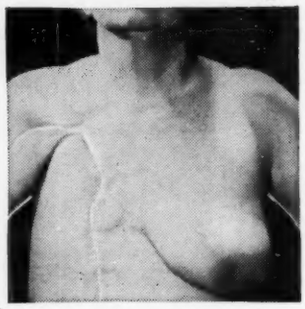

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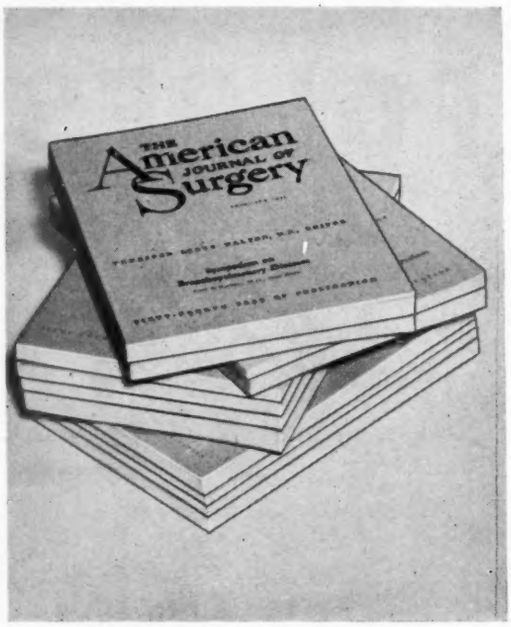

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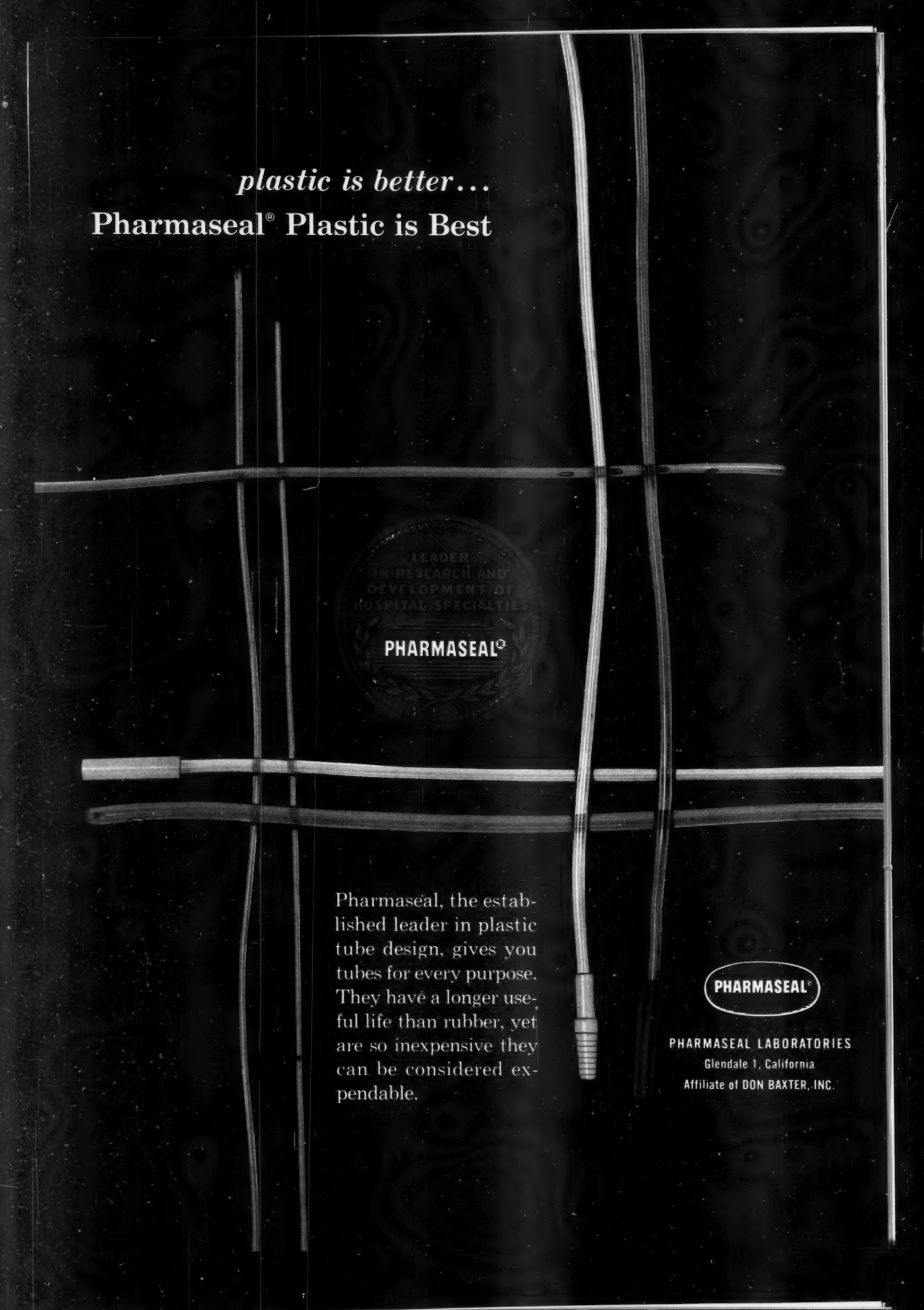
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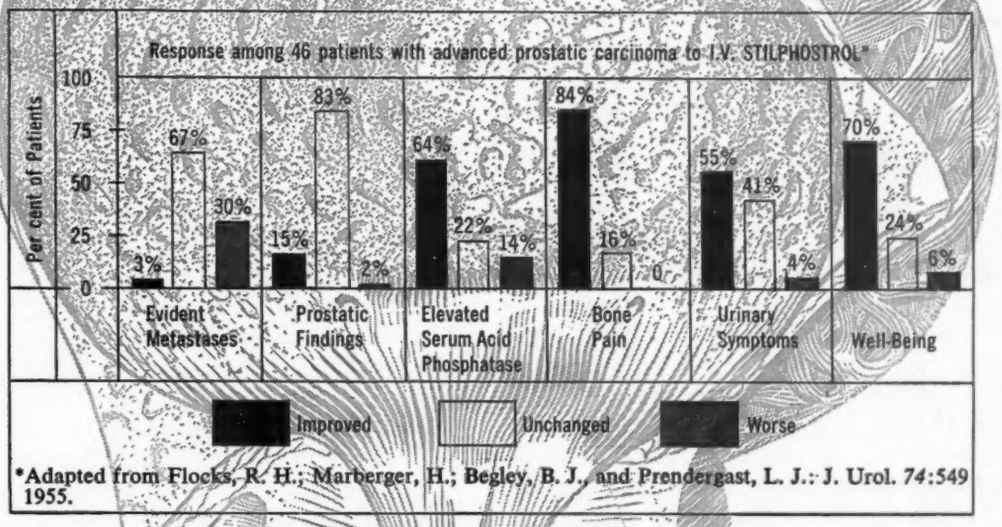

*Adapted from Flocks, R. H.; Marberger, H.; Begley, B. J., and Prendergast, L. J.: J. Urol. *74*:549 1955.

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NOTES AND QUOTES

A UNITED STATES population of 178½ million by the time of the 1960 census is envisioned by the statisticians of the Metropolitan Life Insurance Company. In that event, the 1950's will show a population increase of about 27⅓ million, or two-fifths more than the 1940's, which up to that time had the greatest gain for any ten-year period.

These other features of the nation's population growth are noted by the statisticians:

Since World War II, almost 29½ million have been added to our population, which is more than the gain during the twenty-three years between World War I and World War II.

During 1956, the population, excluding the Armed Forces overseas, increased by 1.8 per cent. Every geographic area shared in this growth, but the Far West showed the highest rate of increase (almost double the national rate).

Since the 1950 census, California has gained more than any other state, about 3.1 million inhabitants. California's population now numbers about 13.7 million, exceeded only by New York State. Nevada, Arizona and Florida have experienced rapid population growth, and increases well above the average rate for the country have occurred in Delaware, Maryland and Michigan.

Losses in population have been sustained since the 1950 census in five states: Arkansas, Mississippi, West Virginia, Vermont and Maine.

Medical schools, like everything else, have undergone many radical changes in the past century. They have grown in size and complexity, their fees have increased, and they have attained a respectability which assures them of a maximum student enrollment so that they no longer have to induce applicants by listing special attractions.

However, the mid-nineteenth century medical schools, such as that at Yale, did not consider it amiss to boast that "three of our professors have been in Europe studying the practice of the most eminent medical men." Considering the fact that Yale's medical faculty then numbered eight, this was a high percentage.

An insight into medical education of the nineteenth century is afforded in a collection of medical school bulletins recently acquired by the library at the Yale School of Medicine. The collection is the gift of Dr. Creighton Barker, Lecturer in Public Health at Yale and Executive Secretary of the Connecticut Medical Society.

The schedule of fees listed in the announcement of the Berkshire Medical Institution at Pittsfield, Mass., indicates that it was possible to get a medical education in 1853 for only $72. This included $50 for the course in lectures, $3 for a matriculation "ticket," $18 for the graduation fee and $1 for a library fee.

Because the value of clinical instruction was not appreciated at the time, many of the mid-nineteenth century medical schools were located in small towns, according to Frederick G. Kilgour, Librarian of the Yale School of Medicine. On the other hand, today they tend to be located in cities, where they have access to large hospitals.

The Yale School of Medicine bulletin for 1853 to 1854 contained six pages and listed a faculty of eight. The current catalog contains 145 pages, and lists a faculty of about 600.

The Yale publication that year boasted that "The Medical Institution is not only free from debt, but has funds permanently invested which will hereafter yield an annual income of about one thousand dollars. *This amount with the matriculation fees will be applied, after paying the contingent expenses of the School, to the increase of the Library, and to the procuring of models, drawings and other means of instruction. In this respect the school offers peculiar advantages to the student."*

The first bulletin of the Bellevue Hospital Medical College in New York City for 1861 to 1862 shows the impact of the Civil War. The Bellevue bulletin advises that "Instruction has already been inaugurated in the College by a course of lectures on Military Surgery, by Prof. Hamilton, and a series of lectures, with demonstrations, by Professor Wood, on subjects of importance to surgeons preparing for the field."

Among its resources, Bellevue noted the fact that "During the year 1860, the number of births amounted to 474. During the same year, 602 police and accidental cases were received, and 149 coroner's cases."

The Dartmouth Medical College announcement for 1880 indicates an awakening interest in clinical instruction. "Examinations will be made and operations will be performed gratuitously before the class," it advised prospective students.

CONTINUED ON PAGE 46

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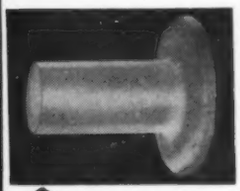

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NOTES AND QUOTES

STERILIZED and filtered air is now readily available in Britain at the flick of a switch controlling a small portable machine operated from the domestic electric supply. The unit, which has been patented in England by Messrs. Penfold & Partners of London, Consultants for Motor and Autofreezer Corporation, sterilizes by radiation of incoming air with short-wave energy of 2,537 A wave length.

The machine operates by means of a fan which draws room air into one end of the tube through special filters. The radiation produced within the machine attacks the cell structure of microorganisms in the air, and the sterilized air is then delivered back into the room from the other end of the tube.

The unit is highly effective against mold, fungus spores, wild yeast and bacteria, recent authoritative laboratory tests showing kills of up to 95 per cent.

The automatic air sterilizer can be used in sickrooms, waiting rooms and operating rooms to reduce the possibility of airborne infection; in schools and hospitals where there are numbers of persons; in research laboratories and similar institutions where sterile conditions are particularly desirable; for food storage to reduce the possibility of contamination or mould growth; in factories and humid workshops to reduce absenteeism caused by airborne infections; and in rooms where fog or smog is able to penetrate, carrying germ-laden air.

Industry in Britain has been quick to see the advantages of a machine such as this, which is both portable and effective and at the same time economic to run.

The Second Inter-American Medical Convention will convene at the Hotel El Panama, Panama City, Republic of Panama, April 3 to 5, 1957, under the sponsorship of the Medical Society of the Isthmian Canal Zone, a chapter of the American Medical Association since 1906. Col. Charles O. Bruce, M.C., U.S.A., *Chief Health Officer of the Panama Canal Company and President of the Medical Society, will act as keynote speaker at the invocation ceremonies, which will include addresses by the President of the Republic of Panama and by the Governor of the Panama Canal Zone. Registration will take place at the Hotel El Panama at 9:00* A.M. *April 2nd, the registration fee being $5.00. The program will be wide in scope, and on the order of a state medical convention in the United States. Speakers will be from North and South America, and all papers will be translated into both English and Spanish. For further information write to Dr. William T. Bailey, Chairman of the Convention Executive Committee.*

THE ASSOCIATION FOR THE ADVANCEMENT OF PSYCHOANALYSIS announces the fifth annual Karen Horney lecture to be given by Dr. Frieda Fromm-Reichmann on "Psychotherapy of Schizophrenics." The meeting will be held on Wednesday, March 27, 1957, at 8:30 P.M. in Hosack Hall at the New York Academy of Medicine, 2 East 103rd Street. A dinner honoring the guest speaker will precede the lecture.

One of the greatest planning problems in the hospital field today is a lack of definition of "fractional" hospitals—whether they be general hospitals, chronic, convalescent or nursing homes, rehabilitation centers, rest homes, mental hospitals or diagnostic centers, George Bugbee, President of Health Information Foundation, said recently.

"Those who are sick especially are caught in this confusion of terms as they seek good and economical care," he said. Moreover, this lack of definition stands in the way of intelligent planning for the future hospital needs of the nation.

Addressing a joint session of the American Association for the Advancement of Science and the American Association of Hospital Consultants at the Hotel Statler in New York, Mr. Bugbee, who formerly headed the American Hospital Association, presented the facts on what is being done now to define convalescent homes. He said these homes "are seeking definitions of what they are, what they should do for patients and their relationship to other types of hospitals."

A Convalescent Care Study Committee, of which Mr. Bugbee is Chairman, is engaged in a two-year investigation of these problems under the combined auspices of the United Hospital Fund, the New York Academy of Medicine and the Hospital Council of Greater New York. This com-

CONTINUED ON PAGE 48

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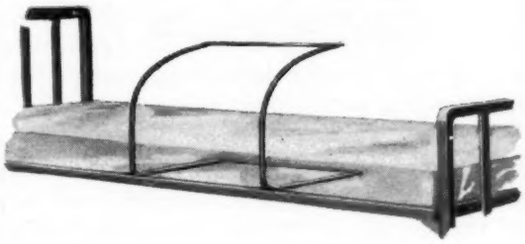

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NOTES AND QUOTES

mittee, scheduled to report late in 1957, has been given a research grant of $50,000 by the United Hospital Fund and asked to study how convalescent homes might define their role in the future and insure that care of proper quality would be available and used by the community.

Mr. Bugbee explained that the committee hopes to establish broader agreement among convalescent homes as to the needs of convalescent patients and the meaning of convalescent care. This is essential, he said, if these homes, as well as other types of institutions concerned with patient care are to keep up with medical advances and the hospital services "expected by the public and the medical profession which largely controls the flow of patients."

THE AMERICAN SOCIETY OF MAXILLOFACIAL SURGEONS announces an essay contest for papers based on clinical and experimental research in maxillofacial surgery. Any medical graduate may submit a paper, which must be in triplicate and based on original work not previously published. The paper should be between 2,000 and 4,000 words in length. Closing date for submission of essays is April 15, 1957. Certificates will be awarded to the authors of the two papers which the committee of judges consider best.

The two winning papers are to be read by the authors before the Annual Meeting of the American Society of Maxillofacial Surgeons, to be held at the Leamington Hotel, Minneapolis, Minnesota, May 12 to 15, 1957.

Burroughs Wellcome & Co., Inc. has made $300 available for the expenses of the winner, and $200 will be awarded for expenses to the author of the paper judged second.

Further information may be obtained from the Secretary, Dr. John A. Drummond, 1414 Drummond St., Montreal 25, Canada.

On February 14th, the Buffalo Surgical Society sponsored the Roswell Park Lecture, this year given by Dr. Alton Ochsner, Professor of Surgery, Tulane University, and Director of Surgery, Ochsner Clinic. The title of the lecture was "Bronchogenic Cancer: Factors which Influence Long Term Survival."

Dr. Ochsner was awarded the Society's Gold Medal, given for the tenth time in honor of Dr. Roswell Park, Professor of Surgery, University of Buffalo, 1883 to 1914.

A NUMBER of extremely important building blocks in multiple sclerosis research were produced in 1956. In fact, accomplishments in 1956 may very well exert a decisive bearing on future achievements in this field of investigation.

Remarkable advancement of the National Multiple Sclerosis Society's ambitious, full scale and long range research program was made, and the Society's Fellowship and Scholarship Program moved ahead and produced its first dividends.

In the realm of fundamental research, the findings reported by Dr. Sarah A. Luse on the morphology of myelin and its relation to the glial and sheath cells were highly significant. Dr. Luse's findings offer new data on the creation and structure of myelin in the nerve fibers of the central nervous system. Thus, research has succeeded in pinpointing more exactly what cells are involved in the formation of myelin and thus, presumably, the focus of the degenerative process where myelin is lost from nerve cells and scar tissue is formed.

A discovery of importance to the clinician as well as the researcher was reported by Dr. Harry M. Zimmerman. The renowned pathologist turned up evidence of the occurrence of beri beri in patients who have multiple sclerosis with accompanying symptoms, some of them similar to multiple sclerosis symptoms. The data were gathered at the Society's central registry of pathologic material.

Another advance was marked with an initial grant by the Society of $15,000 to the Excerpta Medica Foundation. The grant makes available for the first time abstracts of the current world literature on multiple sclerosis and other demyelinating diseases, in the English language, to scientists here and abroad. In the past, the pages of journals in the German, Italian or Scandinavian languages were closed to many scientists not familiar with those languages or who lacked the time to track down articles of importance. This abstracting service opens up the world literature on the demyelinating diseases to all who are interested. Abstracts are given gratis to medical centers, multiple sclerosis clinics, scientists and other interested groups.

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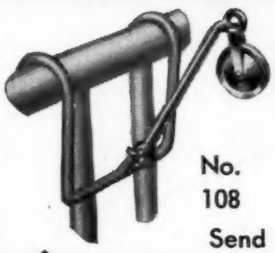

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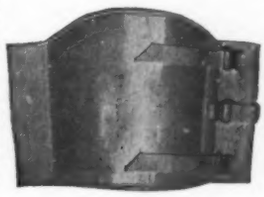

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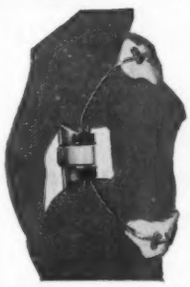

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